537.85
E38 W9

PUBLICATION OFFICES:
168–177 POTTER BUILDING, NEW YORK.
Telephone Call: Murray 586. Cable Address: "Electrical," New York.

W. J. JOHNSTON, Editor and Publisher.
T. COMMERFORD MARTIN, JOSEPH WETZLER, Associate Editors.
G. H. STOCKBRIDGE, Assoc. Editor Patent Department.
CLARENCE E. STUMP, Business Manager.
WALTER T. HUNT, Advertising Dept.

New England Office, 48 Congress Street, Boston.
W. I. BARKER, Manager.
Western Office, 44 Lakeside Building, Chicago.
W. A. KREIDLER, Manager.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.
(Postage Prepaid in the U. S. or Canada.)
CLUBS.—In clubs of 4 or more, $2.50 a year each; with a free extra copy to the getter-up of a club of 8.
Subscription to foreign countries, $4 a year.
In requesting your address changed, give old as well as new address.

THE ELECTRICAL WORLD
HAS THE LARGEST CIRCULATION
OF ANY ELECTRICAL JOURNAL PUBLISHED, AND IS
THE BEST ADVERTISING MEDIUM.

Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished on application covering these points.
Notices of Situations or Help Wanted, $1 to $2 an issue.

Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News**, or information relating to any application of Electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.

Matter for the **Editorial** Department should be addressed to
The Editor of The Electrical World, New York.
Subscriptions and communications relating to **Advertising** or the **Business Department** should be addressed to
W. J. JOHNSTON, Publisher,
Potter Building, New York.
OR EITHER OF THE BRANCH OFFICES.

CONTENTS.

	Page.
ILLUSTRATED ARTICLES:	
Telephoning Without Wires.	198
The Goolden-Trotter Regulator	198
The Sprague System of Electric Motors (continued)	199
Duplexing Telephone Lines.	200
The Lee Temperature Regulator	201
A Novel Electric Gas Lighter	201
The Van Depoele Motor for Street Cars	202
REVIEWS OF NEW BOOKS:	
"Electricity in the Service of Man"	198
POETRY:	
The Voice of the Wires	203
EDITORIAL PARAGRAPHS.	197
MISCELLANEOUS:	
Western Union Annual Meeting	198
Lighting the Bartholdi Statue	201
MISCELLANEOUS:	
The Cost of Horse, Cable and Electric Street Car Lines	201
General Eckert's Breach of Promise Case	201
The Detroit Electric Railway	201
The American Railroad Superintendents' Association	202
Subway Talk and Tests.	202
Preparing Records of Telephonic Litigation	202
Electricians at a Telegraphic Play	203
DEPARTMENTS:	
New York Notes	203
New England Notes	204
Western Notes	204
The Telegraph	205
The Telephone	205
The Electric Light	205
Applications of Power	205
Personals	206
Miscellaneous Notes	206
Sparks and Flashes	206
Stock Quotations	206
Business Notices	206
Our Illustrated Record of Electrical Patents	206

New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

	Page.
E. E. Garvin & Co.—Planers, Lathes and Other Machinery for Electricians	iii
C. E Lee.—The Lee Temperature Regulator	ix
E. S. Greeley & Co.—Victor Telegraph Instruments.	xi
The Empire City Electric Co.—Electrical Novelties	xiv
The Waterhouse Electric & Mfg. Co.—Positive Proof	xvi
For Sale Advertisements	ix

Vol. VIII. NEW YORK, OCT. 23, 1886. No. 17.

IT is said that of about 60 sub-companies and individuals licensed by the American Bell Company, about 50 are paying dividends, with every prospect of continuance in well doing. At present prices—say 213—and paying 16 per cent. annually, the return on the stock of the parent company is only 7½ per cent. This is really a low rate, when we remember that the company has valuable and exclusive patent rights, and never was stronger in any sense than it is to-day.

WHILE for years Prof. Palmieri has been studying atmospheric electricity on Mount Vesuvius, and others in various parts of the world have devoted much attention to it, a conclusive theory with regard to its origin is still to be evolved. But when we consider that in ordinary weather the electrical condition of the atmosphere is undergoing such constant and wide variations that two instruments only a few feet apart give curves differing considerably, though similar in their wider variations, it is not time yet, as Prof. Mendenhall recently remarked, to begin to think of the origin of atmospheric electricity. The problem to be solved at present is its distribution and the relation, if there be any, to weather changes.

AT a little social affair of which note is made on another page, Mr. G. G. Ward, of the Commercial Cable Company, made the statement last week that the company had sent no fewer than 437 messages, in two hours, from the New York Stock Exchange. This is a phenomenal record, and could not be made without good cables and a highly efficient force under able management. A few years ago, such tremendously rapid work would have been deemed utterly impossible.

THE figures presented at the last annual meeting of the Western Union Company, and digested elsewhere in our columns, show that the company has done more work for less pay. The average rate received was 30.9 cents per message, and the average cost 24 cents. Last year the rate was 36½ cents and the cost 24.9 cents. The chances are that there will be little improvement in Western Union finances until rates are restored. The indications are that a return to paying rates may soon be made, and we shall be glad to see it.

LAST week we made a note of the fact that a Kapp dynamo had run continuously for 28 days on board a British man-of war. This recalls a phenomenally long Edison run. In February, 1884, a plant was put in the post-office, Boston, consisting of two of the first type of 250-light machines. Without any previous testing—such was the urgency of the case—they were started, and were operated continuously for 97 consecutive days and nights, when the capacity of the plant was increased without any interruption in supply of current to the circuits. The supply has not ceased, either day or night, from its going into operation in February, 1884, down to the present time. We shall be glad to publish any other figures of long runs by dynamos.

IN a recent issue, we described at length the electric railway system of Mr. Frank J. Sprague, in which his electric motor as applied to that purpose was fully discussed. In the present number, we enter into the description of the general methods pursued by Mr. Sprague in the construction of motors designed for general industrial work under varying conditions. The student will find much food for thought in following out the reasoning upon which the various characteristics of each class of motors is based, and the results obtained in actual practice fully bear out, we believe, the correctness of the theories involved. We have here another instance of the great aid which mathematics brings to the experimenter, in showing the exact relations which exist between the elements that theory points out as dependent upon each other.

THE manner of lighting the Statue of Liberty, to be dedicated to the public next Thursday, is still in dispute, if one may judge from the newspapers, although the work of preparation goes on steadily, and will, it is said, be completed in time. It is a pity that the torch of the statue should be cut or in any way modified, the desire of M. Bartholdi naturally being to light the figure as it stands, but though we do not like the changes that are being made by the Lighthouse Board, we feel it is hardly fair to criticise until the result is made evident. We might regret, however, that time was not taken for preliminary experiments. Perhaps only time can suggest the best methods to be adopted for most successfully carrying out together the two distinct ideas of lighting the statue itself and of using the statue as a beacon. The prospects are that the ceremony next week will be one of unusual interest and importance, and will be participated in by a large part of the population of the city.

THE establishment of electrical communication, using the earth alone as a conductor, may be said to be a "Philosopher's Stone" to electricians. Not that such a method has not been hit upon and tried with some degree of success, for such is the case, but there is one great drawback to such systems, and that is, their uncontrolability. Following its natural course of seeking the path of least resistance, the current passing through the earth as the only conductor does not discriminate between two instruments, upon only one of which it is intended to act, causing interference, and hence any extended application on this plan seems futile to attempt. Professor Dolbear, in another column, shows a new method of telephoning without wires, which is adapted for short distances, but here again, as is pointed out, the lack of discrimination on the part of the current, if the expression may be allowed, does not permit of more than one communication to pass at one time. Still his method is interesting and may be of service in some situations.

THE elements which conduce to success in long-distance telephoning are now well known, and it only remains to put them in practice. The use of copper wire is conceded to be a necessity for this purpose, and by suitably grouping the parallel conductors and by employing metallic circuits the effects of induction can be obviated. If we add to this the application of powerful transmitters, such as those of the Hunnings type, there is now no difficulty experienced in transmitting speech easily over one hundred miles and more—as for instance upon the lines constructed between this city and Philadelphia by the American Telephone and Telegraph Company. But all these methods, especially the application of the double or metallic circuit, entail heavy expenses of construction. The duplexing of such lines, therefore, is a method which suggests itself as compensating for the increased cost of construction, but the earlier methods proposed for accomplishing this were inadequate. The latest method, described in another column, by which good results have been attained, is highly ingenious, and its success will probably give a decided impetus to long-distance telephoning.

WHILE, as a rule, the offering of a prize does not stimulate invention directly to a very great degree, the prospect of early reward has more than once led to the advancement of science and art. Hence, importance attaches to the announcement of the conditions applying to the forthcoming award of the Volta prize in Paris. The Minister of Public Instruction of France has just made known these conditions. A prize of ten thousand dollars is thrown open to competition by all the world, and is to be awarded for success in discovering the best practical application of electricity to any branch of industry. The competition will close on June 30, 1887, and the prize will be awarded in the following December, on the recommendation of a special committee to be appointed by the Minister of Public Instruction. Considering the fact that America carried away the last Volta prize when Professor Bell received it for his telephone, our inventors ought to be prepared to repeat the victory then obtained. America has certainly given to the world more than one practical application of electricity of eminence since the awarding of the last prize, and if we do not carry off the next it may be for want of proper attention to the matter by our inventors.

A FEW weeks ago we published the amendments that it is proposed to make in the constitution of the Telegraphers' Mutual Benefit Association. The most vital of the amendments is that relating to graded assessments. The arguments in favor of a scale or schedule are such, we think, as must recommend themselves to all thinking members of the Association. All genuine and reasonable insurance of life must be placed on such a basis as requires that the older member shall pay more than the younger, and it seems to us that the principle has more than usual pertinency of application in connection with an association like that of the telegraphers. Mr. Bruch, the Secretary, has done well in agitating the matter, and should have universal support. The growth of the organization makes it imperative that the reform or change should be agreed upon, but there is another cogent reason back of that. The Telegraphers' Mutual Benefit Association is represented in the Convention of the Mutual Benefit Associations of America, and the latter body has already adopted and put into force a resolution requiring all associations within its membership to operate under a graded system. The annual meeting of the Telegraphers' Association is held in about a months' time, in this city, when we hope to see a cordial indorsement of the change referred to. The other amendments are also worthy of study, and will, we trust, receive it. The Association is one whose years, usefulness and high reputation entitle it to the highest esteem and utmost vigilance of every member, and nothing should be neglected that can strengthen it or enhance its value.

NEW theories in regard to the origin of meteoric phenomena are constantly cropping up, especially with regard to those heretofore ascribed to the agency of electricity. Thus, according to the recent investigations of a German astronomer on the nature and origin of the aurora borealis, the latter is not to be regarded as connected with any magnetic or electric source. The sun's rays, he says, falling on the earth, are variously reflected according as they fall vertically or at an angle more or less obtuse, and, the earth being conceived as a large mirror, many of the obliquely incident rays will be reflected to a part of the celestial vault on the night side of the earth. The zodiacal light he ascribes to the irregular reflection of the sunlight from water, and similarly the vast fields of ice in the polar regions, he considers, may be regarded as an imperfect mirror, irregularly reflecting the incident light; the rays which fall most obliquely are the most abundantly reflected, and, as the quantity of reflected light increases with the angle of incidence, it may be seen how the reflected sunlight illuminates in the highest degree the night skies of the region nearest the pole—and, further, the great similarity of the incipient light of the aurora is explained thus, the latter being also sunlight reflected; the rays falling on the ice at an angle of forty degrees are, however, dispersed as well as reflected. Having gone thus far, it naturally is incumbent upon the author of this theory to explain away the terrestrial magnetic and electric phenomena accompanying the auroral and zodiacal displays from which their electric origin was inferred *a priori*. He does not, however, convince us by any means and although a complete explanation of the aurora and zodiacal light has not yet been given, we prefer to consider it as of electrical origin, and explainable on that theory.

REVIEWS OF NEW BOOKS.

ELECTRICITY IN THE SERVICE OF MAN: A Popular and Practical Treatise on the Applications of Electricity in Modern Life. From the German of Dr. Alfred Ritter von Urbanitzky. Edited by R. Wormell, D.Sc., M.A., with an introduction by John Perry, M.E., F.R.S. New York: Cassell & Co., Limited. 859 pp. 850 illustrations. 6 × 9 in. Price $6.00.

It is always a difficult task to attempt the review of a great field of applied science in one volume, and the attempt at condensation would seem the more hard in this case on account of the recent enormous progress made in many branches of electricity, each one of which has been the subject of special treatises. With these difficulties before him the author has, nevertheless, produced an excellent volume, which, while avowedly including the whole domain of applied electricity, enters enough into the detail of each branch to give a fair idea of its importance. The sub-designation in the title, "a popular and practical treatise," is somewhat of a contradiction, as books are as a rule divided into these two classes. Yet the words might stand with reference to the work before us, for in it both the layman and the practical electrician will find their demands satisfied to a considerable extent. The title of the work sufficiently explains its contents. It is in fact a *résumé* of all the uses to which electricity has been applied up to the present day. It is not merely a record, pure and simple, however, but gives an account of scientific principles underlying the application, so that the practical man may draw therefrom valuable suggestions. The first part of the book, embracing 224 pages, is an excellent exposition of the principles of electricity. Part II. contains two divisions, one on the Generation and Conduction of Electricity, and the other on the Practical Application of Electricity. The book is profusely and well illustrated and would make a valuable addition to any library. There is only one fault to find with it, which is not due to the author, but to the translator, who has in several instances preserved the original Teutonicisms of his text. We might also draw attention to the fact that, not unlike most foreigners, the author is a little behind in his information as regards the extent of electric lighting in this country. Still, as a whole, the onerous task of preparing this volume has been successfully performed, and we know of no other book, of so encyclopædic a nature, on electricity, nor one that can compare with it for general excellence and thoroughness of treatment.

Telephoning Without Wires.

Numerous attempts have been made in the past to effect electric communication without wires, using merely the earth as a conductor, and it seems that workers are still engaged in this field of research. Among others is Prof. A. E. Dolbear, who has conceived a method by which communication can be established between two or more places using the earth alone as a conductor. His method, which has recently been patented, consists in connecting the transmitting instrument with a ground the potential of which is considerably above the normal, and the receiving-instrument with a ground the potential of which is considerably below the normal, the result being that an impulse from the transmitter sufficient to cause the receiver to give intelligible signals is transmitted through the earth without the need of any circuit.

By referring to the accompanying diagram the manner in which this is accomplished will be understood. *A* and *B* represent two stations, each of which is connected to ground by wires *C* and *D* respectively. *G* is a secondary coil, one convolution of which is cut, the ends thus formed being connected with the poles of the battery *f'*, which has a number of cells sufficient to establish in the wire *C*, which is connected with one terminal of the secondary coil *G*, an electromotive force of, say, one hundred volts. *G* in this instance also represents an induction coil, *T* being a microphone transmitter, *f* its primary circuit, and *f'* its battery—that is, the battery *f'* not only furnishes the current for the primary circuit, but also charges or electrifies the secondary coil *G* and its terminals *C* and *H'*.

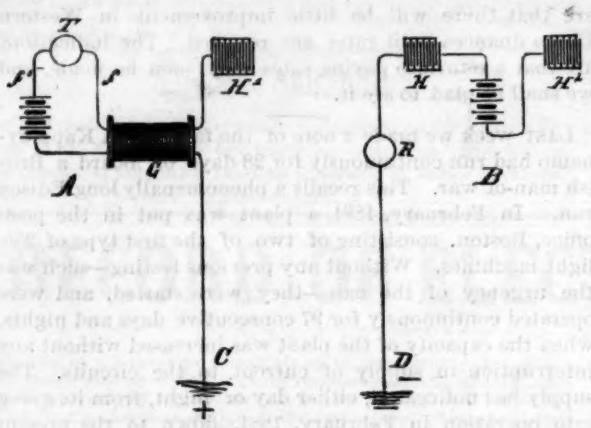
Now, if words be spoken in proximity to the transmitter *T*, the vibration of its diaphragm will disturb the electric condition of the coil *G*, and thereby vary the potential of the ground at *A*, and the variations of the potential at *A* will cause corresponding variations of the potential of the ground at *B*, and the receiver *R* at *B* will reproduce the words spoken in proximity to transmitter *T*, as if the wires *C D* were in contact or connected by a third wire. Electric communication may thus, according to Prof. Dolbear, be established between points certainly more than half a mile apart.

In the diagram *H H' H²* represent condensers, the condenser *H'* being properly charged to give the desired effect. The condensers *H* and *H²* are not essential, but are of some benefit; nor is the condenser *H'* essential when the secondary *G* is otherwise charged. Prof. Dolbear, however, prefers to charge all these condensers, as it is of prime importance to keep the grounds of wires *C* and *D* oppositely electrified, and while, as is obvious, this may be done by either the batteries or the condensers, he prefers to use both.

The main difficulty in utilizing this method on a large scale is, evidently, that when there are many points corresponding to *A* and *B* signals transmitted from any *A* will go to the nearest *B*, or to several *B's*, depending upon proximity and other causes. One method of obviating this difficulty is to use a given *A* only during a certain assigned time for communicating with a certain *B*, the particular *B* being arranged to receive communications only during the assigned time. Thus, if there were ten *B's* within a given area, then the first *B* might be used for the first hour, the second *B* for the next hour, and so on, and the first *A* for the first five minutes of the first hour, the second *A* for the next five minutes, and so on, so that either one of the *A's* might have free communication with the first *B*, each for its assigned time during the first hour, and either *A* with the second *B*, each for its assigned five minutes of the second hour, and so on.

In practice there would be, of course, both a receiver and transmitter at *A* and *B*, proper switches being used to bring either into use, as will be readily understood.

While this method of communication is best adapted to the telephone, any electric instruments may be used capa-

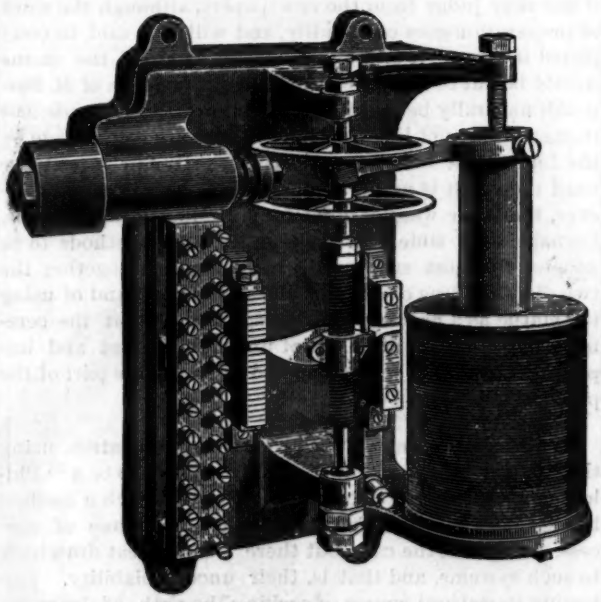


TELEPHONING WITHOUT WIRES.

ble of utilizing the currents passing through the earth from *C* to *D*, and the strength of such currents can be largely increased by increasing the positive potential of *C* and the negative potential of *D*.

Goolden-Trotter Regulator.

This instrument, which is strictly a mechanical, not an electrical regulator, is, says the London *Electrical Review*, for the purpose of governing a dynamo, not an engine. Many engine owners will not allow their engines to be meddled with if they are good enough for their own purpose, but not good enough for the electric light. The instrument is usually constructed to give a regulation of 2 per cent. for a range or variation of 50 per cent., that is to say, if the speed varies from 1,000 to 1,500, the volts will at no time, on a 50-volt circuit, vary more than 1, but it can be made for greater accuracy. It is also very useful, even where the speed is constant, for charging accumu-



GOOLDEN-TROTTER REGULATOR.

lators; the coil is then series wound and the spring adjusted for a certain current; this current will always be maintained. The E. M. F. of the dynamo charging the batteries is automatically adjusted to maintain this current while the counter E. M. F. of the batteries rises. Its action is as follows: The small horizontal shaft is driven by means of a light cord or strap from any convenient part of the main shafting or the dynamo. On the end of this shaft is a small friction disc which gears into one or other of a pair of horizontal wheels, which are lifted in and out of a gear by the core of a regulating solenoid. This core, when the volts are too high, is drawn down, and, by means of a lever, raises one of the horizontal wheels into contact with the revolving disc; the wheel is consequently driven round, and turns a vertical screw which actuates a resistance switch, and inserts a resistance into the field magnets of the dynamo, thus lowering the volts to the normal pressure. In the same way, when the volts fall the core rises, being drawn up by a spring, allowing the [upper horizontal wheel to gear with the disc; this revolves the vertical screw in the opposite direction, and so moves the switch that the resistance in the field magnet is lowered, thus raising the volts.

Western Union Annual Meeting.

At the annual meeting of the Western Union Telegraph Company, held on Oct. 13, three new directors were elected, namely, Messrs. Austin Corbin, John G. Moore and Henry B. Hyde, who take the places of Messrs. Harrison Durkee (deceased), Frank Work and Hugh J. Jewett. There was only one ticket and it was elected without opposition. Mr. Hyde cabled from Europe declining the directorship on the plea that the presidency of the Equitable Life Assurance Society occupied all his time. About 525,350 shares were voted on. It is stated that about 250,000 stand in Mr. Jay Gould's name on the transfer book.

The report of the company for the year ended June 30 was presented and made public. The earnings for the year ended June 30 last compare as follows with those for 1885 and for 1883:

	1883.	1885.	1886.
Revenue	$19,454,902	$17,806,833	$16,298,638
Expenses	11,794,558	12,005,909	12,378,783
Net	$7,660,349	$5,700,924	$3,919,855
Interest and sinking fund	466,911	535,063	534,452
Balance	$7,193,438	$5,165,861	$3,385,403
Dividends	5,199,124	4,999,325	3,399,573
Surplus	$1,994,314	$166,536	.....
Deficit	.....	.....	$14,170

Comparing the official figures furnished in the report as to wire mileage and profits with those for the six previous years it is found that the profits for the last year were only about one-third of their volume in 1880, when the mileage was less than one-half as much as at present, thus:

Year ended.	Wire mileage.	Profit.
June 30, 1880	233,534	$5,333,937.79
June 30, 1881	327,171	5,908,279.72
June 30, 1882	374,368	7,118,070.00
June 30, 1883	432,726	7,660,349.53
June 30, 1884	450,571	6,610,495.70
June 30, 1885	462,283	5,700,924.13
June 30, 1886	489,607	3,919,855.13

Out of these net earnings there is payable at the present time $574,460 per annum for interest on bonds and sinking fund. Add to this the sum of $1,000,000, which is approximately what the Western Union expends annually for construction account, and there remains for the past year only three per cent. net on the present capital stock. A cash dividend was paid only on the first two quarters of the year, a scrip dividend of one and a half per cent. having been declared on the March quarter and none on the last quarter.

In the June quarterly report it was stated that the revenues from current commercial business and news service continued to show a handsome improvement, and that the receipts at "test offices" from Jan. 1 were $110,000 in excess of the corresponding five months of 1885. To explain the fact that this improvement was not reflected in the earnings, it was stated that it was more than counter-balanced by reduced revenues from the cable and commercial news service—in other words, the revenues from cable and commercial news service must, according to this statement, have fallen off more than say $130,000 for the six months, or at the rate of $260,000 for the whole year. But allowing only one-half this ratio of increase for the first half of the fiscal year (July to December, 1885) the amount of increase for the whole fiscal year would be $195,000 from test offices alone. It is always calculated that the test offices represent about one-half the entire Western Union business. This would, therefore, allow a total increase of $390,000 for the fiscal year ended June, 1886, over 1885.

Since the low rates were in force on January 1, 1885, there can be no additional expense for increased commercial business in this year over 1885, except to cover the $390,000 of increased business indicated by the test office reports. This could not have been more than, say, eighty per cent., or $312,000. The monthly rental to "ticker" subscribers in this city was reduced about April, 1885, from $20 to $10 per month—equal to $180,000 per year, or $204,000, allowing that the Western Union company lost, say, two hundred subscribers out of the fifteen hundred. The total cable revenue of the Western Union company for the fiscal year ended June, 1886, was $460,091—a decrease of $232,447. From these figures the following conclusions are deduced:

Actual decrease in cable traffic for the year	$232,447
Estimated loss in "ticker" service	204,000
Estimated increased expenses on account of $390,000 worth of increased business	312,000
Total	$748,447
Estimated increase in commercial business	390,000
Estimated net loss	$358,447

Of a total decrease of $1,779,000 shown by the official reports there remains $1,420,553 to be accounted for by causes other than those named by President Green. The explanation of the Western Union Company does not explain. It would appear that the enormous falling off in net earnings is due chiefly to land competition.

The Sprague System of Electric Motors.

(*Continued.*)

Let us now consider the same class of motors with constant speed, varying load and *constant current*.

Let the resistances and turns be designated as before. Let K be the constant current. Let E be the variable potential at the terminals of the motor and e the variable counter electromotive force.

The work done $= \dfrac{e\,(E-e)}{R+r}$

We must eliminate E making it dependent upon e and the constants R, r, f, and K, and hence the work can be expressed in terms of R, r, f, K, and e, of which e is the only variable quality; e depends upon speed and field, but speed is constant. Hence our conditions require that with the same current we make e, and hence the work, variable, but by changes in the field alone.

$$\text{Field current} = \frac{E}{f}$$

$$\text{Armature current} = \frac{E-e}{R+r}$$

$$\text{But } K = \frac{E}{f} + \frac{E-e}{R+r}$$

$$\text{or, } f(R+r)K = E(R+r) + fE - fe;$$

$$\text{or, } f(R+r)K + fe = E(R+r) + fE;$$

$$\text{or, } \frac{E}{f} = \frac{(R+r)K+e}{R+r+f}, \text{ and } K - \frac{E}{f} = \frac{fK-e}{R+r+f}.$$

$$\text{Moment of shunt field} = m\,\frac{(R+r)K+e}{R+r+f}$$

$$\text{Moment of series field} = n\,\frac{fK-e}{R+r+f}$$

$$\text{Effective moment} = \frac{m(R+r)K + me - n(fK-e)}{R+r+f}$$

Our conditions are such that

$$\frac{e}{e^1} = \frac{m(R+r)K + me - n(fK-e)}{m(R+r)K + me^1 - n(fK-e^1)}$$

$$\text{or, } em(R+r)K + me\,e^1 - nfKe + ne\,e^1 =$$
$$e^1 m(R+r)K + me\,e^1 - nfKe^1 + ne\,e^1$$

Cancelling and transferring, $m(R+r)(e-e^1) = nf(e-e^1)$

$$\text{or, } \frac{m}{n} = \frac{f}{R+r},$$

which is the same law as found for constant potential.

The ratio of moments is $\dfrac{m(R+r)K + me}{nfK - ne}$.

When $e = o$ this becomes $\dfrac{m(R+r)}{nf}$.

But $\dfrac{R+r}{f} = \dfrac{n}{m}$;

hence substituting we have $\dfrac{m\,n}{n\,m} = 1$

That is if the motor is at rest and any current is sent through it a zero field will be produced. This of course follows from what has been already said about the constant potential motor.

The potential E which will exist if $e = E$ and no current is passing in the armature is fK, and the maximum work is done when $e = \dfrac{fK}{2}$. To be self-regulating, the motor can be worked up to this point, but not beyond it, for then the regulating coil works in the wrong direction.

In another variety of motor this series coil is placed outside the terminals of the shunt coil. The laws governing the action of this machine on a constant potential circuit may be described as follows:

Let the same letters of reference be used.

Then the potential existing at the shunt terminals will be $E = rC$.

$$\frac{E - rC}{f} = \text{shunt current;}$$

$$\frac{E - rC - e}{R} = \text{armature current;}$$

$$\frac{E-rC}{f} + \frac{E-rC-e}{R} = C;$$

$$ER - rCR + fE - rfC - ef = CRf;$$

$$\text{or, } CRf + rfC + rRC = fE - ef + ER.$$

$$\text{Whence } C = \frac{f(E-e) + ER}{fR + (f+R)r}.$$

$$\text{Work done} = e\,\frac{E - rC - e}{R}.$$

But since C can be expressed in terms of e and constants, the work can be also expressed in terms of e and constants.

$$m\,\frac{E-rC}{f} = \text{shunt current.}$$

$$nC = \text{series current,}$$

$$m\,\frac{E-rC}{f} - nC = \text{effective current.}$$

$$= m\,\frac{E - r\dfrac{f(E-e)+ER}{fR+(f+R)r}}{f} - n\,\frac{f(E-e)+ER}{fR+(f+R)r}$$

But our conditions are such that

$$\frac{e}{e^1} = \frac{m\,\dfrac{E - r\dfrac{f(E-e)+ER}{fR+(f+R)r}}{f} - n\,\dfrac{f(E-e)+ER}{fR+(f+R)r}}{m\,\dfrac{E - r\dfrac{f(E-e^1)+ER}{fR+(f+R)r}}{f} - n\,\dfrac{f(E-e^1)+ER}{fR+(f+R)r}}$$

$$\frac{e}{e^1} = \frac{mE[fR + (f+R)r] - mr[f(E-e) + ER] - nf[f(E-e)+ER]}{mE[fR + (f+R)r] - mr[f(E-e^1) + ER] - nf[f(E-e^1)+ER]}$$

or, $mEefR + mEef r + mEerR - merfE + merfe^1 - merER - enf^2E + enf^2e^1 - enfER =$
$mEe^1fR + mEe_1fr + mEe^1rR - me^1rfE + me^1rfe - me^1rER - e^1nf^2E + e^1nf^2e - e^1nfER.$

Canceling we have—

$$mfR(e-e) = nf^2(e-e^1) + nRf(e-e^1)$$

$$\text{or, } \frac{m}{n} = \frac{f+R}{R}.$$

That is, the number of turns in the shunt main field bears the same ratio to the number of turns in the series differential field, as the sum of the resistances of the shunt field and the armature bear to the resistance of the armature.

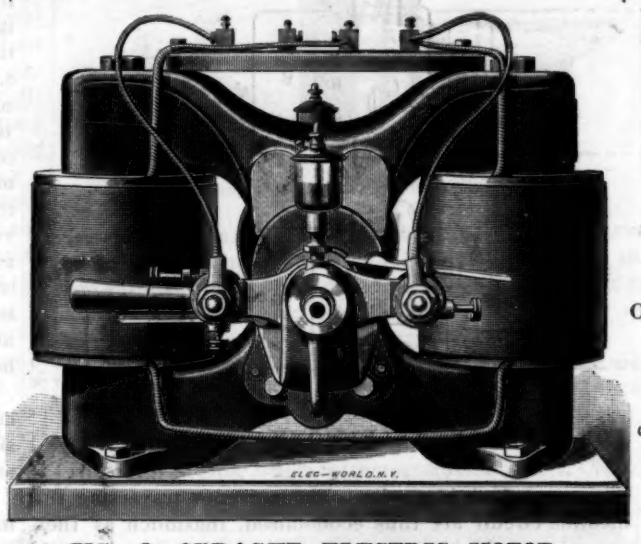


FIG 3.—SPRAGUE ELECTRIC MOTOR.

This is the Sprague law of winding for a machine of this character, and so wound the machine will be self-regulating for any constant potential and for any load up to the maximum allowed, and even with a resistance in circuit and with varying potential.

The same peculiarity exists in those motors which has been pointed out in connection with the first class of differentially wound motors, and this will now be described.

The ratio of the magnetic moments of the shunt and series fields is,

$$\frac{mE - mr\,\dfrac{f(E-e)+ER}{fR+(f+R)r}}{f} \Big/ \frac{nf(E-e)+nER}{fR+(f+R)r}$$

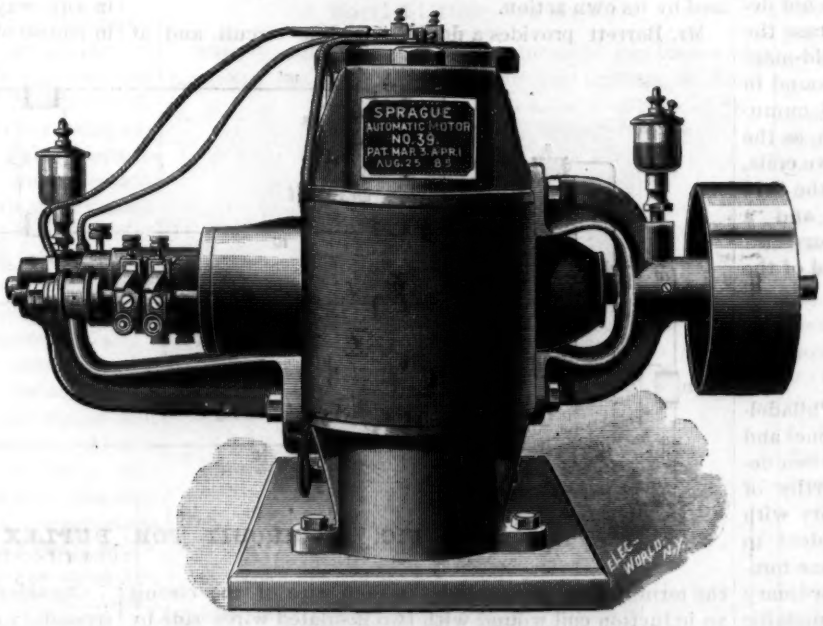


FIG. 4.—SPRAGUE ELECTRIC MOTOR.

$$\text{or, } \frac{mE[fR + (f+R)r] - mr[f(E-e) + ER]}{f[nf(E-e) + nER]}.$$

If $e = o$, this becomes

$$\frac{mEfR + mEfr + mERr - mrfE - mrER}{f^2nE + fnER}$$

$$\text{or, } \frac{mR}{n(f+R)}.$$

But $\dfrac{m}{n} = \dfrac{f+R}{R}$

Hence the ratio becomes $\dfrac{m\,n}{n\,m} = 1$.

That is to say, if a motor of this character is at rest and the series coil in its normal governing position, and the circuit be closed to the motor, a zero field, or nearly so, will be produced; for under these circumstances the magnetic moments are equal, and either the motor will not start at all, or, if it does start, will run at a very great speed, take the maximum current at any given potential, and do little work or none at all.

Referring to the equation $\dfrac{m}{n} = \dfrac{f+R}{R}$ it will be seen that m and $f+R$ can be increased in the same ratio. This means that the determined constant speed of the motor can be varied for any given potential. Also m and n can be increased in the same ratio—that is, if means are provided for varying the effective magnetic moments of shunt and series coils, the motor can be set to run at different determined speeds.

This motor with constant speed, varying load and *constant current* will now be considered.

Let the turns, resistance, etc., be designated as before, E is the variable potential at the terminals of the shunt field, and e the corresponding counter electromotive force.

We must eliminate E and express the work in terms of e and constants; e depends on speed and strength of field, but since speed is constant e depends on the field alone.

$$\frac{E}{f} = \text{current in shunt field,}$$

$$\frac{E-e}{R} = \text{current in armature,}$$

$$K = \text{current in series field;}$$

$$\text{and therefore } K = \frac{E}{f} + \frac{E-e}{R};$$

$$\text{whence } fRK = ER + (E-e)f$$

$$\text{or, } \frac{E}{f} = \frac{RK+e}{f+R}.$$

$$\text{Our conditions are } \frac{e}{e^1} = \frac{\dfrac{mRK + me}{f+R} - nK}{\dfrac{mRK + me^1}{f+R} - nK}$$

$$\text{or, } \frac{e}{e^1} = \frac{mRK + me - fnK - Rn K}{mRK + me^1 - fnK - RnK};$$

$$\text{or } emRK + mee^1 - fnKe - RnKe = e^1mRK + mee^1 - fnKe^1 - RnKe^1$$

$$\text{or } (e-e^1)mRK = (e-e^1)fnK + (e-e^1)RnK$$

$$\text{or, } \frac{m}{n} = \frac{f+R}{R}$$

This is the same law of winding that holds when a machine of the same class is used for constant potential; and the same remarks in regard to the zero field apply as in the former case.

Also, as in the former case, the speed for any given current can be varied by varying the resistance and turns or the effective turns.

From the foregoing demonstrations, it follows that a motor of either class depending for its regulation on this differential winding will regulate with a constant current only when working at less than 50 per cent. armature efficiency; and that the same machine with the same winding will regulate on a constant potential circuit only when working at over 50 per cent. armature efficiency.

The laws above set forth are for pure electro-dynamic motors; if there is any permanent magnetism, as in hard cast iron, or where permanent steel magnets are used, the law of winding is modified in so far as the residual or permanent magnetism is the equivalent of an electro-magnetic moment; but in this case, too, there should exist a zero field if the governing coil is normally closed when the motor is at rest.

The fact already pointed out, that in the best self-regulating motor there is a zero or very weak field when the motor is started, necessitates in both classes of motors, especially when it is desired to start at a speed not greater than the normal, or when there is any load on the motor, in which case there is danger of burning out, the use of devices whereby the action of the governing coil may be modified.

This may be done by the introduction of a resistance, by shunting the coil with a resistance or by the variable shunting of the armature upon the main field. Mr. Sprague, however, prefers to use a switch to short-circuit the governing coil or to short-circuit and reverse it. If it is reversed, then the first rush of current makes a very strong field instead of reducing it to zero or nearly so, increases the rotary effort and prevents the burning out of the machine.

As an instance, if a constant potential motor has the series coil reversed when the full circuit is closed, if there is margin enough on the field characteristic we shall have a field twice as strong as the strongest normal field, four times the strength when the motor is doing its maximum work per unit of time, and a momentary rotary effort eight times that existing when the maximum work is on. As soon as the speed comes up, the governing coil is short circuited and then reversed, and then the motor is self-regulating.

Having obtained a machine which was thus automatic, Mr. Sprague made another step in overcoming the distortion or, rather, counteracting the distortion set up by the armature, by producing a distortion in the field magnets, which is dependent on precisely the same current that flowed through the armature, and he uses two methods, of which one only will be described.

Main field-magnet coils are employed in shunt relation to the armature, differential field-magnet coils in series with the armature, and additional accumulative field-

magnet coils, also in series with the armature. The main field coils may be shunted upon the armature alone, or upon the armature and both the cumulative and differential series coils, or upon the armature and either of the series coils, the other series coil remaining outside the terminal of the main field-shunt.

The object sought is to maintain the non-sparking points of the commutator cylinder constant by opposing the distortion of the magnetic field due to variations in the armature-current by a counter distortion dependent upon such variations, whereby the magnetic resultant due to the armature and field-magnet is unchanged, and the line of parallel cutting of the lines of force or point of least sparking is maintained in the same position.

In accomplishing the counter distortion of the field, the motor used is one in which the field-magnet cores extend in different directions from the field of force in which the armature revolves. The differential series coils are wound or arranged so that their greatest effect is produced on diagonally opposite parts of the magnetic field, and the cumulative series coils, so that their greatest effect is produced on the other diagonally opposite parts. The differential coils are arranged to have a greater magnetizing effect than the cumulative coils. A decrease of load, causing a decreased armature-current, tends to shift the magnetic resultant of the armature and field-magnet; but this also decreases the magnetizing effect of all the series coils, and, therefore, the parts of the field principally affected by the cumulative coils are weakened, and those principally affected by the differential coils are strengthened, whereby a distortion of field is produced opposed to that produced by the decrease of armature-current, and hence the magnetic resultant—the line of parallel cutting and the points of least sparking—remains unchanged. Thus no shifting of the commutator brushes is ever required, except on account of wear.

The arrangement of two sets of series field-coils—one differential, the other cumulative—may be employed simply as a means of field regulation where it is not desired to produce the counter distortion. In such case the coils may be evenly wound on all the legs of the field-magnet and used only to regulate the motor, being wound in the proportions above stated. The differential and cumulative series coils have a differential effect, which, as the differential coils predominate over the cumulative coils, produces a weakening of the total strength of the field magnet when the armature-current increases, and a strengthening of the field-magnet when the armature-current decreases, and so maintains constant the speed of the motor.

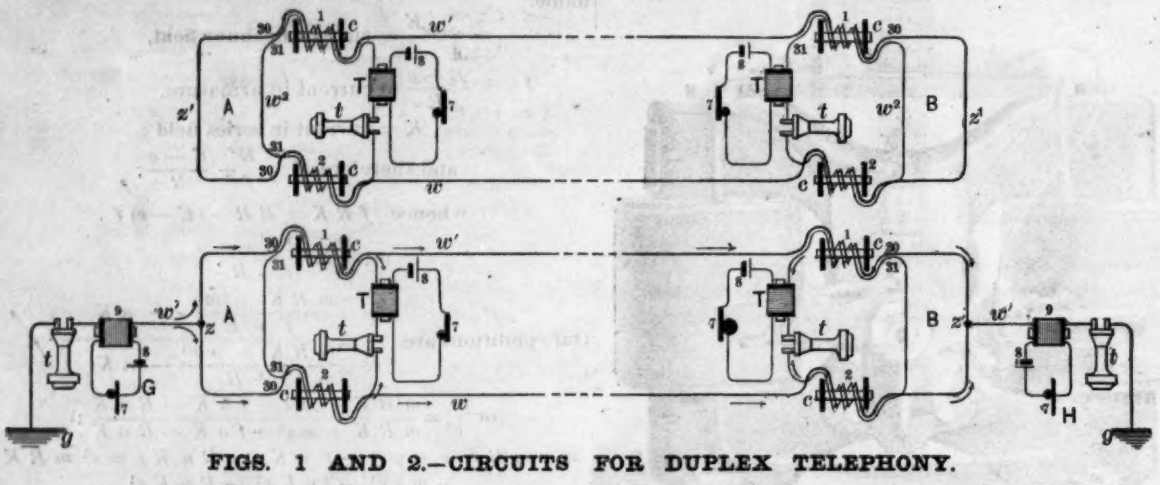
(TO BE CONCLUDED.)

Duplexing Telephone Lines.

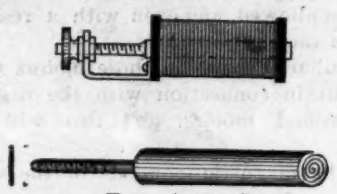
The telephone lines connecting New York and Philadelphia, recently erected by the American Telephone and Telegraph Company, of this city, have already been described in our columns,* as being specially worthy of notice on account of the thoroughness and ingenuity with which the work has been carried out. It was evident to all interested that lines running parallel for over one hundred miles would suffer from induction if the ordinary ground return were employed: hence complete metallic circuits of hard-drawn copper wire were erected, through which the articulation obtained, as we have ourselves tested, leaves nothing to be desired. It becomes manifest, however, that the erection of a double circuit is accompanied by a considerable increase in the cost of construction. Hence it is but natural for the company to seek in some way to increase the capacity of its lines, but still to retain the advantages of the metallic circuit.

The duplexing of these telephone circuits was, therefore, undertaken by Mr. John A. Barrett, of Brooklyn, who has succeeded in devising a decided departure from the former known method. The system heretofore devised for duplexing telephone lines has been to connect the metallic-circuit transmitting and receiving instruments in the bridge wire of a Wheatstone's bridge arrangement of circuits, effecting a balance of suitably proportioned resistances included in the two branches between the bridge wire, and by the union of the direct and return wires, and by including a second set of telegraphic or telephonic instruments in earth branches at both ends of the circuit. In this arrangement the two earth-branch instruments work respondently, the bridge-wire instruments also being adjusted to work with one another only, and being irresponsive to the action of the earth-branch instruments. There are certain difficulties encountered in this method of operating which consist in the fact that a considerable portion of the energy of the current traversing the circuit is dissipated or transformed in the circuit itself in overcoming the balancing resistances, and the operating current is necessarily so subdivided that its action upon the receiving magnets is of a very limited nature.

Mr. Barrett has sought to remove this objection by devising a system which, broadly stated, consists in bringing the metallic or double-wire instruments at the terminal stations into inductive relation by means of converting or repeating induction-coils with both sides of the circuit, instead of connecting them directly with that circuit by means of a bridge-wire. The currents traversing the metallic circuit are thus economized, inasmuch as they are only required to traverse a direct circuit, while the accompanying currents, which are initiated in the earth branch at either terminal station to actuate the corresponding receiving instrument in the distant earth branch, cannot affect the intermediate double-wire instruments,



FIGS. 1 AND 2.—CIRCUITS FOR DUPLEX TELEPHONY.



FIGS. 4 AND 5.

as the current generated by the earth-branch transmitters at any given instant acts upon both sides of the double-wire receivers alike, the current induced in one converting coil being opposite in direction to that induced in the other at the same instant, so that its effect is thus neutralized by its own action.

Mr. Barrett provides a double-wire-line circuit, and at the terminal stations includes in each wire of the circuit an induction coil wound with two insulated wires side by side, one of which wires is directly in circuit with the double-wire line, while the other is connected in circuit with the secondary helix of a telephone transmitter and with the coil of a telephone receiver. Thus messages from a distant station reach the receiver by means of induction through the converting coils, one of which is in the direct and the other in the return wire, while messages spoken in the transmitter develop currents in the secondary circuit of its induction coil, and these again by induction develop tertiary currents of coincident direction with one another in both converting-coils simultaneously, which currents, being of like direction, re-enforce one another and traverse the line to act through like converters upon the distant receiver. To a point of the metallic circuit at each terminal station, equidistant from the converting coils, an earth branch is attached, including the usual telephone instruments. Telephonic currents developed in the transmitters at either terminal station in the earth branches will traverse both direct and return wire in the same direction; that is, in relation to any intermediate point or appliance the current in both lines will be at any given moment positive or negative; hence, while the receiving telephone in the distant earth branch will readily respond to their action the intermediate instruments will be totally irresponsive, for the reasons stated above.

In the accompanying diagram of circuits, Fig. 1 represents the plan adopted of inductively connecting the metallic circuit instruments primarily. As will be seen, there are at each station two converting induction coils, 1 and 2, the two insulating wires of which, of identical gauge and length, are wound together, so that each conductor is in close inductive proximity to the other throughout its entire length. One of the conductors 30 of the converting coils is included at each station, as shown, in the circuit of the direct wires w and w', so that the conductors of each coil are virtually placed in direct circuit serially with the line. The other conducting wires 31 of the coils are joined up in a local or home circuit comprising the receiving or magneto telephone t and the secondary helix of the transmitting telephone induction coil T, the latter being operated in the usual manner through the intermediation of the primary helix by the transmitter 7 and battery 8. The local circuit may be traced as follows: wire 31 of converting coil 1, secondary transmitter coil T, receiving telephone t, wire 31 of converting coil 2, and thence by conductor w^2 back to the starting point. The route of the main circuit in like manner may be traced from an arbitrary starting point z at station A, through wire 30 of converting coil 2, line wire w, through the converting coils 1 and 2 at station B, and back *via* line wire w' and through coil 1 at station A, back to the point z. Each converting coil is provided with a soft iron magnetic core, which is adjustable with respect to the extent of its insertion in the helix spool, for a purpose which will be described below.

The coil with adjustable core is shown in Fig. 4. The latter, as shown in Fig. 5, is provided with a screw extension, so that by turning the thumb-nut it can be advanced or withdrawn from the interior of the coil.

Fig. 2 shows a metallic circuit with its appliances similar in every respect to the circuit and arrangement described in Fig. 1, but with the addition of an earth branch extension-circuit at both terminal stations. This branch w' is at both ends united to the double-wire circuit at a point z or z', equidistant from the two converting coils 1 and 2, and passes through the regular telephone instruments to earth at g. This earth-branch extension may of course be constructed of any convenient length extending to the stations G and H, which may be located at a considerable distance from the points z and z'. The telephone instruments shown at each of these stations G and H consist in this case of a receiving telephone t, and a transmitter 7, in a primary circuit including a battery 8, connected with the branch line w' through its induction coil 9. The instruments in both terminal branches are alike, and a description of one will thus serve for both.

Mr. Barrett has found in practice that stations A and B may freely exchange oral communications without affecting the instruments at stations G and H, and that G and H may in like manner communicate without interfering in any way with messages which may simultaneously be in course of transmission between A and B.

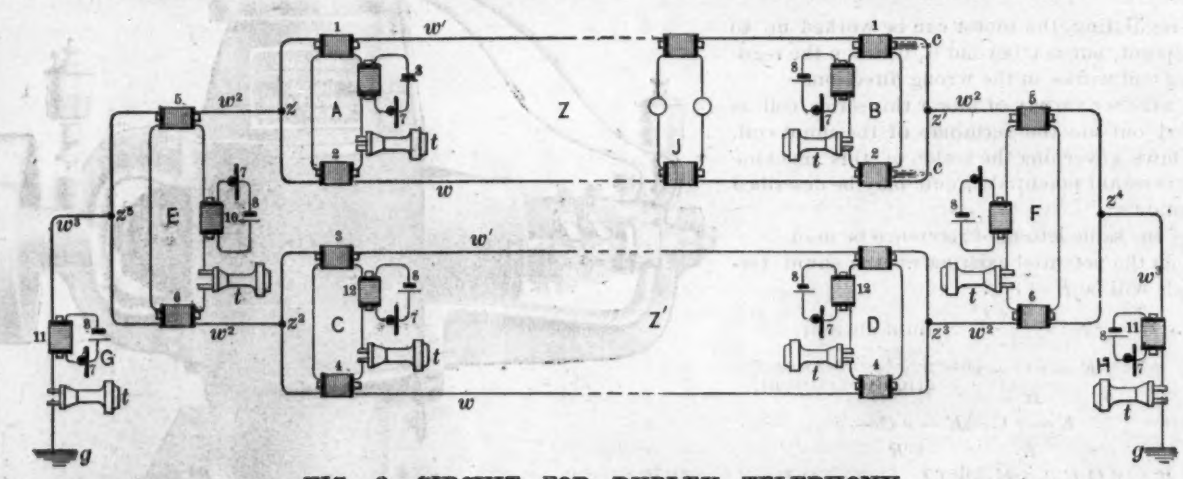


FIG. 3.—CIRCUIT FOR DUPLEX TELEPHONY.

Considering, first, the case of the stations A and B, the secondary electrical current generated in the secondary coils T of the transmitters traverses the conductors 31 of the converting coils 1 and 2, setting up corresponding induced currents therein, which currents, being at any given moment of similar sign in the two coils 1 and 2, re-enforce one another and pass over the line wires w and w' to the distant station B, where, acting inductively through the converting coils 1 and 2, they affect the receiver t, reproducing the message transmitted at station A. The two converting coils at the transmitting station, whether A or B, may thus be unitedly regarded as the source of undulatory electric energy for the double-wire circuit, and may be compared to two separate cells or sections of battery joined up serially, so as to re-enforce one another. They are therefore enabled to act effectively through the corresponding converting coils in the metallic circuit at the distant station upon the receiver there, but have no effect upon the earth-branch receiver, because the currents originated in the metallic circuit (as a metallic circuit) continue to circulate therein without reference to the earth branches at either end of the double line.

Considering, secondly, the case of messages transmitted

* See Electrical World, July 10, 1886.

from the instruments in the ground-branch stations *G* or *H*, any communication originating, for instance, at the station *G* will be transmitted by the instrument 7, and will, of course, initiate secondary currents in the coil 9. These voice currents, upon arriving at the junction point *z* divide, as indicated by the arrows, and proceed partly upon the wire *w* and partly upon the wire *w'* to the distant station *H*. Arriving at the point *z'*, they reunite and affect the instruments included in the earth branch at station *H*, reproducing the original messages in the receiver *t*. The receivers at *A* and *B* do not respond to these voice currents because they pass through the wires 30 of the converting coils 1 and 2 at both *A* and *B* with equal but opposite effect, the current induced in the wire 31 of 1 being opposite to that induced in the wire 31 of 2. The resultant effect, therefore, in the metallic circuit receivers is an absolute neutrality or nullity. This neutrality is, however, contingent upon the equality in resistance and inductive power of the corresponding converting coils 1 and 2. They must be wound as nearly as possible with equal amounts of insulated wire of the same gauge, and an exact balance of inductive power is effected by varying the extent to which the magnetic cores *c* are inserted into their respective spools. Mr. Barrett has found that by ordinary manual variation alone a substantial balance can readily be effected. By adopting a screw adjustment, using a micrometer or differential screw, as in Fig. 4, the balance can be brought with great ease to a perfect exactness; and it has also been found that a most efficiently operating core can be made by rolling up soft sheet-iron into a circular form, as indicated in Fig. 5.

Fig. 3 shows the extension or elaboration of the principles involved. Two separate double-wire circuits *Z* and *Z'* are employed, each corresponding in every feature to the circuit described in Fig. 2. These are united at each end by a loop wire w^2, provided on each of its arms with a converting coil 5 and 6. These coils bring into inductive relation to the line additional sets or stations of telephonic apparatus *E* and *F*, and the wires *w* and *w'* of the circuit *Z* serve together as one side of the line circuit for these additional stations, while the wires *w* and *w'* of the circuit *Z'* serve in like manner unitedly for the other side of said line. Earth branches w^3 at both ends may again be attached to the electrical centres z^4 and z^5 of both of the above-described loops and contain the stations *G* and *H*. It will be seen that this principle of connection is capable of indefinite expansion. At station *B* in Fig. 3 the adjustability of the converting coil cores *c* is indicated by dotted lines.

Way stations may readily be connected with any of the double-wire circuits, as shown at *J*, the connections being arranged in precisely similar manner to the terminal double-wire stations.

The usual signaling appliances are of course in practice combined with the above system, as will be readily understood.

Lighting the Bartholdi Statue.

The great torch in the right hand of the Bartholdi Statue of Liberty was last week altered for the purpose of the intended illumination of the statue. This is the first change made from the original design of M. Bartholdi, the sculptor, and will materially change the intended appearance of the torch. Instead of cutting a strip of bronze out of the flame, thirty holes have been made, which makes the flame look like a huge sieve instead of a solid sheet of flame. The aperture will be filled with circular pieces of plate glass, through which the light will shine. The disfigurement of the torch was made at the request of the lighthouse authorities on Staten Island, who have been placed in charge of the lighting arrangements.

The first project was to place the electric lamps on the balcony surrounding the torch, after the fashion of the Hell Gate lights. This would illuminate the statue and light the harbor in the vicinity of Liberty Island. As it is now arranged the light will not be visible within a mile and a half of the statue, and cannot be seen from the Battery or Governor's Island. At a distance, the change made in the torch cannot be detected, but from the water in the neighborhood of the island and from the pedestal the apertures change the effect intended by M. Bartholdi.

There will be probably eight lights of six thousand candle-power each on the balcony at the base of the flame, which will throw a cone of light up to the clouds, and will be visible a great distance. The circular holes in the metal forming the flame of the torch will be filled with colored glass, probably red. Within will be one large electric light, the rays of which, passing through the colored glass, will give a natural glow to the cone of light passing upward. There will be probably fourteen lights of fifty candle-power each around the crown.

At the base of the pedestal there will be placed several 8,000 candle-power lamps for the purpose of lighting the outside of the statue. These lights will be put at the angles of the parapets and provided with parabolic reflectors to throw the light upon the statue. A number of small incandescent electric lights will be placed at intervals along the staircase in the pedestal and in the interior of the statue to light the passageway up to the balcony around the torch.

The order for the engine to run the plant has been given the Armington & Sims Company, of Providence.

The Lee Temperature Regulator.

The approach of cold weather makes us all look about for some means of keeping an even temperature in rooms heated from furnaces, and hence, the description of a recently introduced temperature regulator operated by electricity will be of interest.

The apparatus which is shown in the illustration, Fig. 2,

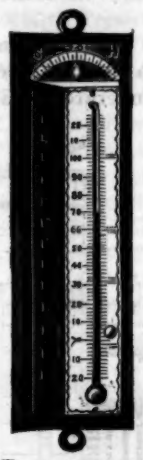


FIG. 1.—LEE TEMPERATURE REGULATOR.

consists of a damper moved by a magnet acting on an armature, which swings in front of it in such a manner that the damper is both opened and closed by the action of the magnet and the circuit remains open except at the moment that the damper is moving.

The thermostat used, shown in Fig. 1, is of the usual form of bi-metal strip, and is provided with an adjusting lever and a graduated scale by means of which it can be set at any desired temperature.

This apparatus, which is manufactured by Mr. Chas. E.

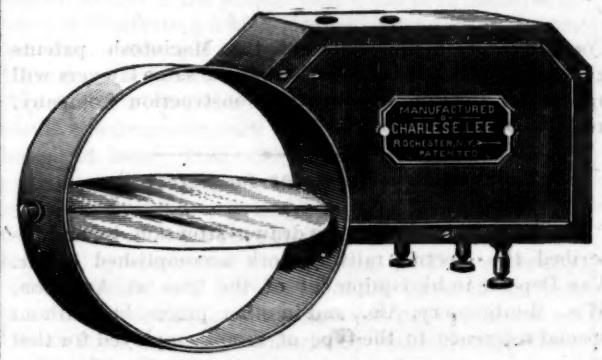


FIG. 2.—LEE TEMPERATURE REGULATOR.

Lee, of Rochester, N. Y., can be applied either to the smoke-pipe as a check-damper, opening to let in cold air, or it may be used as a pipe-damper, and operated by partially closing the smoke-flue.

A Novel Electric Gas Lighter.

With the idea that the existing forms of gas burner can be easily converted into electric gas lighters, M. Ernst

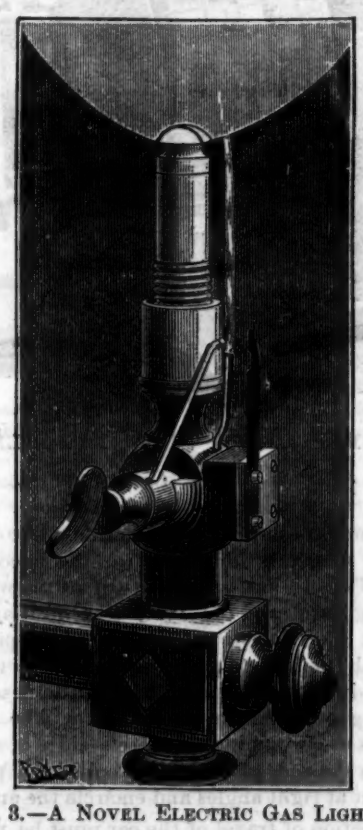


FIG. 3.—A NOVEL ELECTRIC GAS LIGHTER.

Née has devised the arrangement shown in the accompanying engraving taken from *La Nature*. The gas cock, as will be seen, carries a small rod which strikes against an insulated spring, connected to which one terminal of the battery and spark coil is attached. At the breaking of contact between the rod and spring when the cock is turned, a spark is formed in the usual way. So far, there is nothing new in the apparatus. But it will be seen that instead of lighting the gas direct, the spark only ignites a small jet which issues from a tube at the side, and this in turn lights the flame above. The egress of gas from the small tube can only take place when the cock is turned halfway, as shown; hence, when fully turned on, the igniting jet is extinguished and waste of gas is prevented. Some practical objections might be raised to the burner illustrated, in its present form, but the idea is quite a novel one.

The Cost of Horse, Cable and Electric Car Lines.

The Bentley-Knight Electric Railway Company, of this city, issued recently a pamphlet showing the comparative cost of running horse-car, cable and electric roads. They figure on five miles of double track, forty cars, headway two and a half minutes, average speed six miles an hour.

Estimate for newly constructed lines:

Cost of horse road	$162,000.00
" electric road	344,100.00
" cable road	414,750.00

Annual expense of motive power for

Horse road	$102,960.00
Electric road	30,641.50
Cable road	75,500.00

Annual saving in cost of motive power:

Electricity over horse	$72,318.50
" " cables	44,948.50

The company's figures for a new electric road are as follows:

Estimate on cost of building and equipping an electric tramway operating 40 cars over 5 miles of double track; headway, 2½ minutes; average speed, 6 miles an hour.

Track, 10 miles @ $5,000	$50,000.00
Cars, 40 @ $800	32,000.00
Conduit, 10 miles @ $11,660	116,600.00
Steam power plant	27,500.00
Building and foundation	11,000.00
Dynamos	44,000.00
Motors, 40 @ $1,200	48,000.00
Engineering	15,000.00
Total	$344,100.00

Annual expense of motive power:

Coal, 5 tons per day @ $2.50	$4,562.50
Engineer and assistant	1,500.00
Firemen (3)	1,800.00
Lubrication	540.00
Interest on motive plant (6 per cent. of $247,100)	14,826.00
Maintaining plant, 3 per cent.	7,413.00
Total	$30,641.50

General Eckert's Breach of Promise Case.

A special dispatch of Oct. 16 from Wooster, O., says: The most important case ever tried here, springing from an old love affair and involving many delicate legal technicalities, was reopened to-day in the Court of Common Pleas. In September, 1845, Mary E. Flemming, of Wooster, sued Thomas T. Eckert, now general manager of the Western Union Telegraph Company, for a breach of promise to marry. She obtained a judgment of $2,250. The execution was issued in 1850 and returned unsatisfied. Eight years later the judgment was renewed in the name of Mary E. Bartol, the plaintiff having in the meantime married. In 1855, the attorney for Mary E. Bartol was granted a motion to renew the original judgment. In June a motion was filed through Eckert's attorney, John McSweeny, to quash the case. The motion was argued before Judge Parsons and sustained. This morning M. A. Dougherty, of Columbus, appeared as the attorney of Mary E. Bartol, and took steps to open up the case and have Judge Parsons' decision reversed. It is certain that there will be a hot contest. The case is watched with great interest, owing to its age and the prominence of the parties to the suit. The great question seems to be upon the construction to be given to the statute of limitations, particularly in respect to the revival of judgments. The plaintiff's attorney insists that the motion is not to revive the original action, but that it is simply a continuation of jurisdiction once acquired.

The Detroit Electric Railway.

The Highland Park Electric Railway, by which name the railway now being equipped at Detroit is known, will soon be in practical operation. Just west of Woodward avenue has been built a substantial power-house of brick, in which a nest of new steel boilers has been placed, besides a new engine and two dynamos. The railway is built along the west side of the plank road until the toll-gate is passed, when the track makes a slight curve still further west to avoid the toll-house and to return, after it is passed, again to near the plank road. The track has been very thoroughly built, and, in fact, everything connected with the establishment has been furnished of the best with a view to permanence and economy in the end.

The current is led to the motor by a central rail supported upon glass insulators, not unlike telegraph insulators, two of them being placed side by side and supporting the rail in the grooves formed in the glass. In addition, the rail is fastened by wires to the insulators.

The current returns through one of the rails, and an E. M. F. of 300 volts is employed, each motor requiring 30 ampères, which power it is calculated will be sufficient to drive the car at a speed of 10 miles an hour. The mo-

tor employed is the invention of Mr. Frank E. Fisher, and it is said to embody several novel features.

The projectors of this railway, three miles in length, and claimed to be the longest electric railway in the country, are Capt. W. H. Stevens, Frank E. Snow, John B. Corliss, W. A. Jackson, F. Woodruff and others, and the work of building the road and station has been done under the supervision of Mr. Jackson, well known as an able and practical telephonist.

The American Railroad Superintendents' Association.

The above association held a very largely attended and interesting convention in this city on the 14th inst. The president of the association, Mr. Wm. H. Stevenson, read a short paper on the Phelps system of railway telegraphy. He illustrated his remarks by citing several practical illustrations of the use of the system on moving trains. He also stated that his experience with the system upon his road (the New York, New Haven & Hartford Railroad) for the last eighteen months was uniformly satisfactory. Mr. Stevenson urged and recommended the adoption of this excellent system of telegraphy and affirmed that it was the only system that had stood every practical test. He said that it had been in use on his road for six months and that it was invaluable. His remarks were listened to with deep attention by the members of the association present.

We understand that the Phelps Induction Telegraph Company will probably in a short time close a contract with the New York, New Haven & Hartford Railroad Company, for extending this system upon that road to Springfield, and later on to Boston. As mentioned in our columns a few weeks since, the Phelps system is now being placed on the Lehigh Valley Railroad. We understand that the Phelps Company is pushing the use of its improved system upon several of the prominent lines of the country, and it now looks as though railway telegraphy would soon become one of the actualities of the day.

Subway Talk and Tests.

The latest development in subway matters is the generally credited report that negotiations are now in progress which will probably result in an entire reorganization of subway matters. The parties to it are Messrs. Gould and Sage, representing themselves individually, and incidentally the Western Union Company; Mr. Vail, the president of the Metropolitan Telephone Company; Mr. Edward Lauterbach, of the Subway Construction Company, and Contractor Cummins. The proposition now under consideration is that the various telegraph and electrical companies whose wires are strung through the city shall take stock in the subway enterprise in proportion to the needs of their business, present and prospective. As this plan would give the Metropolitan Telephone Company the controlling interest in the stock, Messrs. Gould and Sage objected to it. The suggestion was then made that each company should still subscribe according to its needs, but that each should have exclusive control over the ducts included in the subway which represented its own investment. Messrs. Gould and Sage were disposed to accept this arrangement, and if the present interests in subway affairs can be bought off at a reasonable price, this new deal will, without doubt, it is said, be completed successfully within a short time.

Colonel Kipp, chief clerk of the Board of Police, wrote to Corporation Counsel Lacombe last week that the Harlem Electric Light Company was stringing wires through the streets of Harlem without the authority of the Mayor and the Board of Aldermen, but under a permit from the Electric Subway Commissioners. The Police Commissioners wanted to know whether they should respect such permits. The Corporation Counsel replied that permission to string wires above ground given by the Subway Commissioners was in no sense a grant of power, but was simply a dispensation from obeying the acts of 1884 and 1885. Mr. Lacombe also sent a letter to the Subway Commissioners, saying he presumed they had made some inquiry as to the legal rights of the Harlem Electric Light Company before granting the permit, and asking to be informed of those rights.

The report having been circulated that the Dorsett Company had managed to secure the entire contract for laying the electric subway conduits, Mr. Flower stated that any such proceeding was impossible, because the commission could change the specification for each section, and the construction company would have to follow their directions. There were indications that the electric light companies were vigorously looking for new ways of carrying their wires. Mr. Flower said he did not believe the companies would be embarrassed by the commission if they had need of poles previous to the completion of the conduits. He believed that permission to use poles would be readily granted, as it had been to the various telegraph and telephone companies.

The Beere-Grant system has been again brought to the attention of the commission. The Averell system has, as noted in another column, undergone a successful mechanical test in Brooklyn. The consideration of the commission has been invited to the plans of the New York District Railway Company for its work in Broadway, where the tunnel for the tracks will naturally furnish space for the wires.

The counsel for the Subway Commission are busy in preparing an answer to the bill of complaint entered by the North American Underground Electric and Telegraph Company for infringement of the Macintosh patents granted in 1872. It is probable that the same lawyers will appear for the Commission, the Construction Company, and the Dorsett Company.

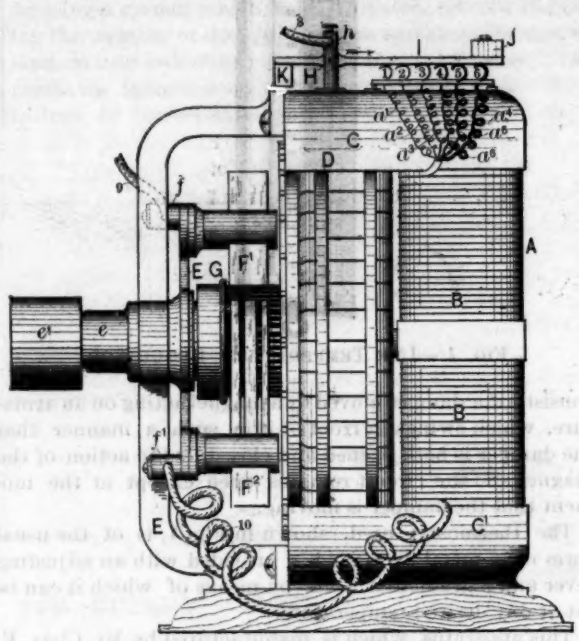


FIG. 2.—VAN DEPOELE MOTOR.

The Van Depoele Motor for Street Cars.

We have at various times drawn attention to and described the electric railway work accomplished by Mr. Van Depoele in his equipment of the lines at Appleton, Wis., Montgomery, Ala., and in other places, but without special reference to the type of motor employed for that purpose. Hence a description of the latter will be of interest.

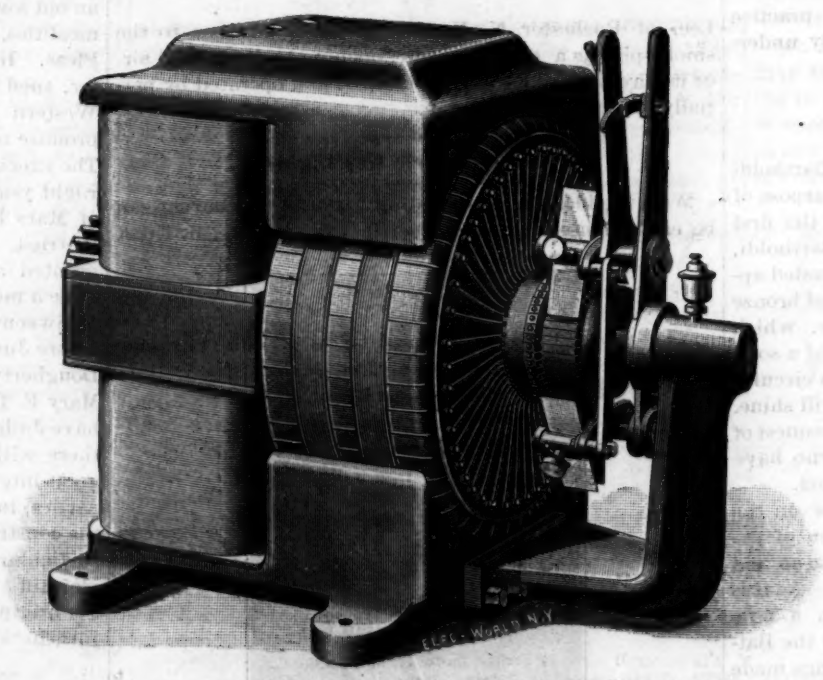


FIG. 1.—PERSPECTIVE, VAN DEPOELE MOTOR.

The motor which is illustrated in the accompanying engraving, Fig. 1, has an armature of the well-known Gramme ring form, and the shaft rests in bearings, one of which is a bracket bolted to the lower pole-piece, while the other is the neutral point of the field magnets. Having special regard to the attainment of compactness, the field magnets are given the form shown. It will be seen that the field coils are wound on the two sides of a cast-iron upright upon the ends of which are bolted the pole-pieces which project at right angles and encircle the armature.

As the direction of travel of the car must be under control, two pairs of brushes are provided by which the direction of rotation of the motor can be changed at will. Each pair of brushes is attached to a brush holder provided with a lever, by the shifting of which either pair can be brought in contact with the commutator. The end of the armature shaft carries a gear wheel, which meshes into another attached to the car axles.

In order to provide for the regulation of the motor so that it may run at different speeds, and without the use of external resistances, Mr. Van Depoele adds to the ordinary field magnet coils additional ones, which are successively connected to each other in series and are also in series with the main field coils. This is shown diagramatically in Fig. 2, which represents the method adopted for the automatic regulation of the motor. It will be seen that the coils a, a^2, etc., are brought out to spring terminals over which is placed a contact bar I. One end of this bar carries an adjustable weight J, which tends to press down on the terminal, 1, 2, 3, etc. The other end of the contact bar is provided with an iron armature K, in close proximity to the surface of the pole-piece C, so that when attracted by the magnetic condition of the latter the other end is drawn away from the contact springs, thus cutting out the resistances.

This arrangement, shown in Fig. 2, is evidently intended for motors in which it is desired to keep the current and speed constant. But in the motor shown in Fig. 1, which is applied to the street cars where these conditions do not prevail, a system of hand regulation has been adopted. The auxiliary field coils are connected to a commutator which is manipulated by hand, and by means of which any speed from rest to maximum can be obtained.

Preparing Records of Telephonic Litigation.

It is said that Deputy Clerk Shields and Assistant Deputy Clerk Thornton, of the United States Circuit Court, this city, have been occupied for five weeks in the preparation of the records in the great telephone cases, which are to be argued before the United States Supreme Court. The heavy volumes of printed matter were forwarded last week to Washington. The transcripts were contained in two volumes, one of which had over 7,000 printed pages, the other nearly 5,000 pages. One of the volumes was about two feet high and the binding together of so many pages proved a difficult piece of work.

The two suits are that of the American Bell Telephone Company against the People's Telephone Company, commonly known as the Drawbaugh suit, and that of the American Bell Telephone Company against the Overland Telephone Company. Final decrees were entered in each case in favor of the validity of the Bell patents. The testimony and arguments touch upon every question involved in telephone litigation since the patents were granted in 1876, and against the validity of the patents to Alexander Graham Bell the defendants have set up the alleged priority of the inventions of Reis, Gray, Edison, Drawbaugh, McDonough, Dolbear and others, and the cases have occupied the attention of judges for months at a time for several years past. Many of the most prominent patent solicitors and other lawyers in the country have appeared in these cases, among them being Messrs. Dickerson & Dickerson, the late George Gifford, Roscoe Conkling, Wheeler H. Peckham, Charles P. Crosby, Henry C. Andrews and George Harding, of this city; Senator George F. Edmunds, of Vermont; ex-Judge Hill, of Washington, and James J. Storrow, Chauncey Smith, George L. Roberts and Causten Browne, of Boston. Other telephone suits involving some of the issues raised in these suits were appealed a long time ago, and are on the present calendar of the United States Supreme Court. The counsel on both sides of the litigation purpose, it is understood, to ask the court to hear final arguments on these two cases, as well as those now on the calendar, so that not only the issues raised in the earlier cases, but all the disputed points in the long litigation, may be passed upon at the same time by the highest judicial authorities. Besides this testimony the justices will have before them a large amount of testimony taken in other cases, as all the testimony in the Dolbear and almost all the other suits involving the telephone patents has been introduced, by stipulation, in the Overland case. Gray's alleged anticipation, on which the Government case brought in behalf of the Pan-Electric Company rests, is the foundation of many of the issues raised in these suits, and the whole matter will probably be decided before the Ohio case is passed upon by the judges before whom an argument was recently had.

Death of Thomas M. Carnegie.—On Oct. 19 Mr. Thomas M. Carnegie, of the firm of Carnegie Brothers & Co., Limited, died at his residence at Homewood, Pa. He was taken ill with what seemed like a slight cold last Thursday while at his office, and went to his home. His illness became rapidly alarming, and Dr. Semple discovered that he was suffering from pneumonia. Like his brother, Mr. Andrew Carnegie, he had a remarkable career. He was born in humble circumstances at Dunfermline, Scotland, Oct. 2, 1843, came to America and went to Pittsburgh with his father, mother and brother in 1847. He was engaged, when young, in the telegraphic department of the Pennsylvania Railroad Company, where his brother Andrew had been previously employed, and became an expert operator. He died worth $2,000,000.

The Voice of the Wires.

(From "The Main Line," Act. IV.)

Sometimes, upon the busy wires,
The gentle winds breathe sweet and low,
As if they found them tuneful lyres,
On which to whisper as they go.

When wintry winds go roaring by,
They stir to louder, wilder tones,
Or, sinking to a murmuring sigh,
Breathe out a message full of moans.

The tones seem full of joy or woe,
Or bring to pain a sweet release.
I listen, as the wild winds blow,
In hopes my heart may find some peace.

I, listening, wait if I may hear,
In all their tones, one word more clear—
One message meant alone for me:
"I come, dear heart, I come to thee."

Electricians at a Telegraphic Play.

It is but rarely that an opportunity is afforded of witnessing a play in which telegraphy and electricity are prominent features. The new and excellent telegraphic drama, "The Main Line," by Messrs. H. C. De Mille and Charles Barnard, has been running at the Lyceum Theatre, in this city, for the past month to crowded houses. In fact, the piece proved so much of a success that $1,500 bonus was offered for the privilege of remaining at the Lyceum two weeks longer.

THE ELECTRICAL WORLD likes to encourage anything that aids in developing the electrical business. It was pleased to see the recognition of telegraphy and electricity in "The Main Line," and as, outside of its especial interest to electricians, the play was such a good one, we thought it would be a neat thing in its way—it would at once compliment the authors and give a pleasant evening's entertainment to a number of electricians—if it should invite the representative metropolitan telegraph, telephone and electric light men to attend the performance of "The Main Line," and to meet the authors of the piece after the play.

It was thought, as noted above, that "The Main Line" would remain two weeks longer than it did in New York, before going upon the road. It was found at the last minute, however, that it would not, and when the arrangements for the electric party were completed, only thirty-six hours remained in which to extend invitations and get the party together to witness the performance on Friday evening, Oct. 15, the last night but one in this city. The time was so very short that it was hardly believed to be possible to make the affair a success. THE WORLD always dislikes to undertake anything unless it can do it well, and it was thought that in view of all the circumstances the proposed theatre party would have to be abandoned. This seemed a pity, however, and it was decided, after thinking the matter over, to at least make the attempt. Personal invitations were extended to as many representative electricians as could be seen in the short time left, and the result was exceedingly gratifying. Over fifty well known electricians and their friends gathered in the Ashland House, opposite the theatre, and went across to the Lyceum in a body. Among those present were the following gentlemen:

R. W. Aborn, Treasurer Brush-Swan Electric Light Company.
F. S. Hastings, Secy. and Treas. Edison Company.
Charles Barnard, Author "The Main Line."
Gen. C. H. Barney, Secretary National Telephone Assn.
R. G Brown, Standard Multiplex Company.
C. P. Bruch, Secretary Telegraphers' Mutual Benefit Association.
H. T, Buel, Daft Electric Light Company.
J. H. Bunnell, of J. H. Bunnell & Co.
W. M. Callender, Secretary Callender Waterproofing and Insulating Company.
W. C. Camp, of the New Haven Clock Company.
J. W. Carter, Secretary United States Electrical Company.
Charles Cuttriss, Electrician Commercial Cable Company.
H. C. Davis, President Sawyer-Man Electric Light Company.
Carl Faber, of the United States Electrical Company.
E. H. Goff, President American Electric Manufacturing Company.
F. E. Goodrich, Business Manager Brooklyn Electric Construction Company.
M. W. Goodyear, Manager E. S. Greeley & Co.
W. T. Hunt, of THE ELECTRICAL WORLD.
H. D. Hall, Phelps Induction Telegraph Company.
W. M. Habirshaw, President India Rubber and Gutta Percha Company.
Clarence Healy, Superintendent Commercial Telegram Company.
J. S. Hall, manufacturer of dynamo oil-cups.
Wm. Hochhausen, Electrician Superintendent Excelsior Electric Company.
H. E. Irvine, Secretary and Treasurer American Electric Manufacturing Company.
W. J. Johnston, Publisher THE ELECTRICAL WORLD.
E. R. Knowles, Brooklyn Electric Construction Company.
J. C. Kemble, Associated Press, California State Agent.
P. V. Luke, Superintendent of Indian Telegraphs (Calcutta, India).
D. B. Macquarrie, Manager Kansas City Telephone Exchange.
T. C. Martin, Associate Editor THE ELECTRICAL WORLD.
Romaine Mace, Secretary Vitrite and Luminoid Company.
G. W. Mansfield, Daft Electric Light Company.
W. C. Nicholson, Associated Press, Cable Department.
J. D. Reid, of the Western Union Company.
Geo. H. Stockbridge, Manager Johnston's Patent Agency.
J. E. Smith, Superintendent N. Y. Fire Telegraphs.
Clarence C. Sibley, of the New Haven Clock Company.
L. Samuel, Manager "The Main Line" Company.
W. J. Sefton, Secretary Subway Construction Company.
J. A. Seely, Electrician Metropolitan Telephone Co.
F. J. Sprague, of Sprague Motor Company.
C. E. Stump, Business Manager THE ELECTRICAL WORLD.
S. S. Wheeler, of the "C. & C." Motor Company.
J. Wetzler, Associate Editor THE ELECTRICAL WORLD.
G. G. Ward, General Manager Commercial Cable Company.
G. L. Wiley, Standard Underground Cable Company.

Few recent plays produced in New York have enjoyed so great a success upon their merits as "The Main Line." A critique of the piece appeared in these columns some weeks ago, and the favorable opinion then expressed has been emphasized by the verdict of the public, who, if they cannot appreciate the accuracy of all the technical details in a play so realistic, are keenly alive to the humor and pathos of a truthful presentation of life in a railroad telegraph office in the sparsely settled Far West.

It is happy that when the work of the telegraph operator is selected for dramatic treatment it falls to the care of such competent and able authors as have joined their forces in writing "The Main Line." The theme might have been cheapened and vulgarized, but in the present case it has been made the occasion of illustrating a high ideal of life and duty on the part of those who toil at the key. Besides, the play is not all shadow. "Contrast of character is not enough," says Mr. John Morley in his life of Diderot, "we crave contrast in the dramatic point of view. We seek occasional change of key. That serious comedy should move a sympathetic tear is reasonable enough; but it is hard to find that it grudges us a single smile. Laughter rightly stirred is one of the most powerful agencies in directing the moral sympathies of the audience." This, evidently, was the thought of the writers, whose piece brims over with fun of the most innocent and exhilarating character.

There are a number of remarkably realistic stage effects in "The Main Line." In one of the scenes is a regular Western Union Telegraph office complete in detail, and the principal female character sends and receives messages on the stage, by the aid of a key and sounder, reading the dispatch aloud for the benefit of those present. The actress studied telegraphy, so as to be able to do this. There are also *bona fide* electric signals, and railroad tracks run across the stage, while wires run overhead.

At the close of the performance, which was heartily enjoyed, the party, accompanied by the authors of the play, returned to the Ashland House, where supper was awaiting them.

There was but one toast—that of the authors—and it was responded to by Mr. Barnard and by Mr. de Mille, both of whom expressed their pleasure at finding the play so warmly approved by those connected with the electrical profession. Mr. James D. Reid, Mr. Ward, Mr. Luke, Mr. Seely, Mr. Hastings and Mr. Sprague, each in turn speaking for the developments of electricity that they represented, congratulated the authors on their success and wished that the play would have a long run.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
Oct. 18, 1886.

The Averell subway people have at last succeeded in giving, as they have long desired, a good exhibition test of their conduit. The experiment was made last Saturday at the works of the Averell Company in Brooklyn. Among those present were: Mr. Roswell P. Flower, President of the Subway Commission; Assistant Engineer North; Mr. John Thomson, engineer, and Mr. Sefton, secretary of the Subway Construction Company; Messrs. McNulty and Beckwith, electricians of the Metropolitan Telephone Company; Superintendent Brown, of the Western Union's underground department; R. L. Harris, and many other representatives of electrical enterprises. Gen. W. W. Averell, the inventor and patentee of the material and processes exhibited, explained his claims and the peculiarities of his system, urging its simplicity, rapidity of construction, avoidance of joints between manholes, impermeability to moisture or gas, durability, and great cheapness. He then exhibited a section thirty feet in length, made at the request of the Subway Construction Company on specifications furnished by their engineer. Engineer Thomson went at this with hammer and cold chisel, penetrating it at the end with apparent difficulty, and uncovering a small portion of the paper tube lining the ducts. The tube was found in perfect shape, its texture uninjured by the heat to which it had been exposed in the molten material. The material of the conduit was of close texture, exceedingly tough and firm, and apparently capable of resisting any reasonable pressure. It had been cast in a wooden retaining box, so shaped at the ends as to prevent contraction in cooling without fracture. It exactly filled the box, with no sign of contraction nor any flaw. The test was esteemed a most successful one as regards the mechanical questions involved. The conduit will be tested electrically and otherwise. The raw asphaltum and silica of which the concrete is made was shown the company, as was the machinery employed in the manufacture. The silica was then put into the oven and heated to about 250°. The asphaltum was melted at the same time in an open caldron. The two materials were brought together in a mixer, where they were stirred and agitated for about five minutes, then drawn off for use. A prism about fifteen feet long, with a single duct, was made, the whole process consuming less than half an hour's time. This exhibition was made to show the simplicity of the work and the rapidity with which it could be done. One gentlemen said there need be no trouble in laying two miles a day of it with the improvised facilities there shown. A number of small blocks carrying naked copper electric light wires were cast for the use of the electricians in making further and more technical tests. But so far as the purely mechanical side was concerned, the exhibition was pronounced by all present to have been in the highest degree satisfactory.

The United States Electrical Company, of New York and Brooklyn, have a new trade discount list; it is worth while looking at. With this list and the company's catalogue, one ought to find out how to get first-class goods cheaply.

I hear that the Waterhouse Electric and Manufacturing Company, of Hartford, are making large shipments of apparatus to the Harlem Electric Illuminating Company, of 242 East 122d street, this city, who have adopted the Waterhouse system. The Harlem company are fitting up a very fine central station, and word from them as to the plant is that they are fully satisfied with it and with the prospects of business.

Messrs. Edward R. Knowles, Theodore E. Otis, Charles T. Carter and G. Mortimer De Mund, all residents of Brooklyn, and Augustus A. Levey, of New York, are the trustees of the Mutual Electric Manufacturing Company, incorporated at Albany last week. The amount of capital stock is placed at $100,000, divided into 2,000 shares of $50 each. Its objects are to manufacture, use and vend electricity for light, heat, power and other mechanical and chemical purposes, and to manufacture and sell electrical machines, etc.

The Manhattan Electric Company, of 737 Broadway, has recently been reorganized, and is now under very strong management. Mr. B. J. Sturgis, director of Lloyd's Plate Fire Insurance Company, is president; Mr. C. P. Frey is secretary. The trustees are: Mr. J. P. Haynes, of Hartford, Conn., the largest grocer in that city; Mr. A. D. Ellinwood, of James McCreery & Co., dry goods, this city; Mr. R. T. Whiting, a prominent grocer of Bridgeport; Mr. S. Chichester, a director of electric lighting companies in Brooklyn; Mr. Julius Pinney, of the Willimantic Linen Company; Dr. F. Van Wooert, a leading Brooklyn dentist. Mr. E. Hurlburt is the general manager, and will give special attention to electrical business. The company are sole owners of the "window tapper," that now invites the attention of passers-by to hundreds of stores, and they control other desirable novelties as well. They are arranging to operate a factory in New York for the production of their specialties. Mr. Frey, who will act as their electrician, comes fully qualified. I have seen a letter from the President of Harvard College, wherein he states that Mr. Frey had charge of the laboratory and electrical experiment department of the college for two years.

Hazazer & Stanley, manufacturers and dealers in annunciators and electrical supplies, 32 and 34 Frankfort street, are successors to E. W. Hazazer. Mr. Hazazer, who is well known in the business, is joined by Mr. A. F. Stanley, formerly with the Western Electric Company. I hope the new firm will do well.

The Gutta Percha and Rubber Manufacturing Company, corner Warren and Church streets, this city, make a specialty of "Monarch" belting for dynamo machines. They say it will not slip on the pulley, is perfectly balanced in weight throughout, and is proof against atmospheric changes. This rubber belting is largely and successfully used and often under very trying conditions. The company are the sole manufacturers, and have factories in Brooklyn, San Francisco and Toronto.

E. E. Garvin & Co., manufacturers of machinery that is well known to electricians, are busy on their special screw-cutting machines. They are making with success all kinds of drills, both upright and horizontal, for special work.

The Electrical Supply Company has completed a full exhibition "line" of its gravity annunciators and burglar alarms, to which attention has already been called in your columns. The goods are beautifully made, and a praiseworthy feature is the exposure of all the works, so that there is no need to take them apart to see how they look. There is no trouble in making connections, and the circuits can easily be run or changed after the apparatus is put up. Another full line shown by Mr. Hungerford is that of bells from a little 2½ inch style up to the "tocsin of the soul, the dinner bell." The company is pushing the "C & C" motor, and sales are reported as very good. The Haskins electric light hanger deserves to be more in use around New York for the fronts of stores, halls, etc. You can lower the lamp for renewing carbons, and when the lamp is raised again for use, the strain is taken off the cord. The company is paying its wonted attention to carbons and batteries, and if a new continent rose out of the sea off New York to-morrow, it would readily take the contract for filling all its wants in the line of telegraph, telephone, and electric light supplies.

I hear some very hearty commendations on Mr. Goff's action in presenting to the authorities as a gift all the apparatus required for lighting the Statue of Liberty. The cost cannot be less than $10,000. At the present time of writing, Mr. Wood, the electrician of the American Company, is busily engaged making the dynamo and the double lamps. The work of wiring the statue will be one of no small difficulty, and, altogether, the achievement of "lighting up Liberty" will be something for any company or individual to be proud of.

W. T. H.

ROCHESTER, N. Y., Oct. 16, 1886.

The Edison electric light station in this city was started on Saturday evening, the 9th inst., with a capacity of 8,000 ten-candle power lamps, of which 5,000 go at once into service. The station is a handsome brick building on Aqueduct street, 82½ feet by 70½ feet, two stories high. The boiler-room contains at present

six boilers of 150 horse-power each, made by the Woodbury Engine Company, and all the steam fittings are of the best description. Power is furnished by two Armington & Sims engines and two Porter-Allen engines with Judson governors. The lights are run by eight of the largest and most improved dynamos made by the Edison Company, and the electrical equipment of the station throughout is very perfect. The officers of the company are: J. L. Judson, President; Albrecht Vogt, Vice-President; Geo. C. Hollister, Treasurer; H. L. Brewster, Secretary. This is the largest underground installation in this country outside of New York City. Some of the heaviest consumers of light are the new Osburn House, 350 lights; the Stein Manufacturing Company, 315 lights; Hayden Furniture Company, 250 lights. The Rochester station has been put in running order by Mr. William S. Andrews, of New York City, chief electrical engineer of the Edison system for isolated lighting.

W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Boston, Oct. 18, 1886.

Mr. Edward S. Sears, treasurer of the Citizens' Electric Light ompany of East Boston, has been elected manager of the Merchants' Electric Light and Power Company of this city, to succeed Mr. Homer J. Goff, who has accepted an important position with the American Electric Manufacturing Company, of New York.

Sealed proposals were opened at the office of the lamp department, City Hall, on the 14th instant, for furnishing electric ghts for public street lighting for a period of three years from he date of contract. Each lamp will be required to burn every night in the year from sunset to sunrise, or during 3,828 hours, according to a time schedule furnished by the superintendent of lamps. The competing companies are the Merchants' Electric Light and Power Company, Brush Electric Light Company (of Boston), the New England Weston Illuminating Company, the Citizens' Electric Light Company of East Boston, and the Charleston (Mass.) Gas (and Electric Light) Company, each of whom offers to furnish the required light at sixty-five cents per lamp. The first-named company also offers to supply from one hundred to three hundred lights for fifty-five cents per lamp. The bids were taken under consideration.

The students of the Massachusetts Institute of Technology are divided as follows, viz.: School of Industrial Science, 623; School of Mechanic Arts, 37; Lowell School of Design, 60; total, 720. The late Professor Nichols bequeathed his library to the Institute, and it has recently been placed in the library of the chemical department. It is very extensive and valuable, comprising 1,000 volumes of chemical literature in all languages. Many complete sets of rare works are present, and nearly all important works of this and of the preceding century in French, German, English and Latin. Some of the books date back to the early part of the seventeenth century. The chemical department of the Institute has, by this generous bequest, the most complete and valuable library of any college in the country.

The Waltham (Mass.) Gas and Electric Light Company has completed its canvass of the city for electric light patrons for incandescent as well as arc lights, and for both commercial and domestic use. The result has been very satisfactory, a large number of orders having been taken for both kinds.

Biddeford, Me., soon will have its streets lighted by electric lights. At a special meeting of the city authorities on the 13th instant a committee was appointed to select what they considered a good system of electric lighting, and to contract for or purchase a complete equipment for a forty-five light plant.

Salem (Mass.) has one of the most successful local electric lighting enterprises in New England. The repairs and alterations that have been going on for some time past at this station are nearly finished. The increase in the equipment includes an engine of 150 h. p., from the works of the Fitchburg Engine Company, the driving-wheel of which is ten feet in diameter and is to run a 24-inch belt.

At a meeting of the Newton (Mass.) City Council, on the evening of the 11th inst., an order was adopted providing for the drafting of an ordinance regulating the erection and operation of electric light, telephone and telegraph wires through the streets of the city. At the same meeting the Committee on License reported in favor of granting the petition of the Newton Electric Light and Power Company for leave to run its lines through certain streets, subject to any existing or future ordinances.

The Jarvis Engineering Company, 61 Oliver street, Boston, are th New England agents for the sale of the Armington & Sims Company engines. Their trade this season has been better than ever before. Among their recent sales are orders from the following concerns:

Portsmouth Electric Light Company, Portsmouth, N. H., one engine.

Para Rubber Shoe Company, So. Framingham, Mass., one engine.

New Haven Electric Light Company, New Haven, Conn., one engine.

Merchants' Electric Light Company, Boston, Mass., one engine.

Byron Weston, Dalton, Mass., one engine.

Cocheco Manufacturing Company, Dover, N. H., one engine.

Natick Electric Light Company, Natick, Mass., one engine.

Le Page Liquid Glue and Cement Company, one engine.

Woonsocket Electric Machine and Power Company, Woonsocket, R. I., one engine.

D. S. McDonald, Boston, Mass., one engine.

Fall River Electric Light Company, Fall River, Mass., one engine.

Waltham Gas and Electric Light Company, Waltham, Mass., two engines.

Continental Clothing House, Boston, Mass., one engine.

Stevens & Co., Haverhill, Mass., one engine.

Asa Cushman & Co., Auburn, Me., one engine.

The petition of the Newton Electric Light and Power Company to erect poles in the streets of the city having been granted, as above, that company proposes to begin the erection of its plant at once. Already there is a demand for lights for store purposes, and it is more than probable that many of the finest residences will soon be lighted by incandescents. The city being under contract with the Newton & Watertown Gas Light Company until next spring, it is thought that no electric lights will be contracted for by the city authorities until after the expiration of that contract.

On Oct. 13, Mr. Homer J. Goff, having severed his connection with the Merchants' Electric Light and Power Company, of Boston, as general manager, the employés of the company and several of his friends presented him with a gold watch, the works of which are of the highest grade made by the Elgin Watch Company. Engraved upon the watch is the following inscription:

"Presented to Homer J. Goff
By his friends and employés of the Merchants' Electric
Light and Power Company,
Boston, Oct. 13, 1886,
On his retirement as general manager."

Mr. Goff has been in the service of the Merchants' company since its organization some four years ago, at first as collector, then as assistant general manager, and for the past two years as general manager. He has been a most efficient and faithful officer, has made many friends during his term of service, and has especially endeared himself to the men in the employ of the company under him, as the valuable gift of remembrance by them testifies. Mr. Goff, after a few weeks' vacation, will connect himself with the business of the American Electric Manufacturing Company of New York, of which his brother, Mr. Edwards H. Goff, is president and general manager. His friends in Boston wish him the best success in his new field of labor. You in New York will be glad to make his acquaintance.

W. I. B.

Lynn, Mass., Oct. 16, 1886.

The proposed route selected for laying the wires of the Woodward Underground Telephone and Telegraph line is through Munroe, Market, Franklin and Boston streets to the Peabody line, these connecting with the Salem (Mass.) branch lines. The Boston connection will intersect at Franklin street, running through Western avenue to Saugus line. The work will commence as soon as the city authorities grant the necessary permit.

The Thomson-Houston Electric Company has recently constructed at its works in this place a very powerful electric light for the steamer St. Domingo, of the Clyde line, running between New York, Philadelphia and Charleston. This light is of six thousand candle-power, and is to be used upon the vessel's prow to enable her officers to ascertain the location of buoys in laying the course of the steamer into harbor and up rivers. The light has been satisfactorily tested for one or two nights past on top of the company's building on Centre street, West Lynn. The light was so intense that papers were read with ease on High Rock, and it was seen from Stoneham, Salem and other points.

W. I. B.

Hartford, Conn., Oct. 14, 1886.

Since Sept. 1 the Mather Electric Company, of Hartford, Conn., through its Southern agency at Atlanta, Ga., has furnished a 125-light incandescent plant to the Georgia Marble Works at Elizabeth, Ga., and a 125-light incandescent plant to the Brookside Mills, Knoxville, Tenn. Through its Cincinnati agency a 250-light plant has gone to the publishing house of A. H. Pugh, Cincinnati, and a 25-arc light plant to Samuel Gideon, Huntington, West Va. The company has furnished direct the following also since the 1st of September:

Olden Mills, Haledon, N. J., 150 incandescent plant.

Putnam Woolen Mills, Putnam, Conn., 300 incandescent.

G. H. Whitcomb & Co., Worcester, Mass., 250 incandescent.

Cheney Bros.' New Velvet Mills, South Manchester, Conn., 75 arc.

Tyler & Carmichael, Westerly, R. I., 50 incandescent.

Otis Bros. & Company, Yonkers, N. Y., 50 incandescent.

The Mather Company has made since Sept. 1 additions to plants previously installed as follows:

Bristol Hosiery Company, Providence, R. I., 100 incandescents.

Thornton Worsted Mills, Providence, R. I., 100 incandescents.

Train, Smith & Co.'s Paper Mills, Bristol, N. H., 75 incandescents.

Peter Adams & Co., Bucklands, Conn., 150 incandescents.

W. I. B.

WESTERN NOTES.

Branch Office of The Electrical World,
Chicago, Oct. 16, 1886.

It will be seen by the following clipping from the Indianapolis *News* that that paper is expecting to see the three-dollar telephone law repealed at the next session of the Indiana Legislature: "The Citizens' Co-operative Telephone Company is, according to one of the officers, awaiting for the old company (Central Union) to pull up stakes and move. From present indications the wait will be a long one, as the Central seems to be settled for the winter and consequently for all time, since the legislature will probably undo the ineffectual law by which it was proposed to regulate the use and price of telephones. The co-operative company protests that it will begin the erection of poles and lines within twenty-four hours after the Bell Company is served with notice to quit. The old Board of Trade room has been leased for a telephone exchange by the Wallace people, and several private lines, it is said, will be put up at once. This company claims that the Central is receiving from some patrons as high as $15 and $20 per month for telephone service, while $3 is the highest legal rate."

Mr. Forée Bain has lately turned out quite a number of his electric light machines, both arc and incandescent, on orders from the Domestic Heating and Illuminating Company, of Chicago. Mr. Bain's arc machine is already well known, and his incandescent outfit is very neat and efficient.

The American District Telegraphic Messenger Company has been incorporated here, with a capital of $250,000. A. W. Nohe, O. W. Maurice and C. R. Richardson are among the incorporators.

Mr. F. S. Terry, manager of the Electrical Supply Company here, is east.

A terrific wind storm burst upon Chicago from the southwest at 8:15 o'clock Thursday morning, and tore through the city with the fury of a hurricane. The storm was a very destructive one. Young trees were twisted off at the roots, many small buildings were demolished, street car drivers and conductors were nearly blown from their cars, and the streets were littered with shivered sign-boards and other *débris*. The telegraph wires suffered severely, of course. In fact, it was said by one official of the Western Union, that never in the history of the local office had the service been so badly crippled, except at the time of the great fire; and the other offices were no better off. The wires were down in every direction, and the great city of Chicago was completely cut off from the outside world. At one time there was not a single wire out of Chicago working to any of the principal cities.

As late as ten o'clock at night all the Western Union wires east were still down with the exception of one to New York, which was worked by way of Louisville, Cincinnati, and Philadelphia. The chief trouble was between Chicago and Cleveland, and also Toledo and east of Detroit through Canada.

At the operating rooms of the Bankers and Merchants' and the Postal Telegraph companies it was said the lines about Chicago began to go down about 11 o'clock. One wire was in working order to Cleveland at 10 o'clock in the evening, but east of that point business was suspended. All business for the West was being handled in good shape.

The Baltimore and Ohio people were working a wire to New York in the evening by way of Cincinnati, Newark, Ohio, and Baltimore. The chief trouble was between Fort Wayne and Cleveland.

Mr. B. E. Sunny, Superintendent of the Chicago Telephone Company, said that the company usually had about one hundred instances daily of lines being down or instruments out of order, while on Thursday the complaints amounted to four hundred The trouble arose chiefly from falling trees. The damage to the company's lines extended all over the city, but the northwestern portion of the town suffered to the greatest extent. Outlying towns, and especially Evanston, he said, had been greatly troubled by lines being down. The company usually employs a force of 25 repairers in Chicago, but on Thursday 110 men were sent out.

The telegraph and telephone companies make their repairs very rapidly, and the effects of this, the most disastrous storm of years to them, were pretty much all effaced by Friday night, and Chicago's communication with the outside world was re-established.

David Leary, 42 years old, and recently from Syracuse, N. Y., was found dead under a sidewalk at the southwest corner of Randolph and Dearborn streets, Thursday. He was employed by the Thomson-Houston Electric Illuminating Company, and went beneath the walk to put in some wire. It was at first supposed that he had been killed by an electric shock, but there was no circuit at the spot. Heart disease is thought to have been the cause. The body was removed to the morgue.

Hammond, Ind., is to have the electric light, and Vassar, Mich., is contemplating its use.

I am informed that the Underwood patent cotton leather belting is in use by over one hundred electric light companies, and that fourteen thousand feet of it was recently placed in a Memphis manufacturing concern. This belting is highly spoken of, and the following remark by a gentleman of large experience in the use of belting was lately made regarding it:

"I knew when the first patent cotton leather belt was introduced and then prophesied that it would some day become a strong competitor in the belting world; I have yet failed to hear of a single instance where it has failed, when ordinary care was given it, and some of the largest concerns in the country are using it." The Underwood Manufacturing Company, Tolland, Conn., manufacture this belt, and Goulds & Austin, Chicago, are the Western agents.

The Van Depoele Electric Manufacturing Company are building a 150 horse-power dynamo to be used in connection with their motors at Montgomery, Alabama. The machine is a monster, and will be finished in a few weeks.

Manager M. A. Knapp, of the Railway Telegraph Supply Company, tells me that business was never so good with him as at present, and that the indications point to a still further increase.

The Western Electric Company are furnishing a large number of American District boxes to a new company in St. Paul, Minn.; also a 40-light electric light outfit for San Bernardino, Cal.

When in New York City a few days ago, I was much impressed by the large number of electric motors in use there, in connection with small manufacturing plants, elevators and for a variety of other purposes. The enthusiasm exhibited by the users of these motors is surprising. I talked with the proprietors of a number of establishments where these clean and untroublesome little machines were doing daily work, and in every case they were not only satisfied but delighted. The dirt and bother from fuel and ashes are avoided, no expensive plant is necessary, and the work required to be done is accomplished in the most satisfactory manner possible. I understand that these small motors are employed as extensively in proportion in Boston, Philadelphia and Baltimore, as in New York. I am sorry to say, however, that such is not the case in Chicago. I wish we had more of them here, and I presume we soon will have. But which company will furnish them?

The Fort Wayne Jenney Electric Light Company have now, at Fort Wayne, Ind., one of the finest, if not the finest, buildings devoted to the manufacture of electric light apparatus in the United States. Their new brick factory was designed especially for their needs, and covers three and a quarter acres of ground. It is finely equipped for its work, and is at present running an unusally large force of hands. It is probable that this large force will have to be retained permanently, as the company's business is increasing steadily, and their apparatus is becoming more and more popular. The company are fortunate in having one of the brightest men in the business for a general manager, and this, together with the inherently good qualities of the apparatus furnished, insures a permanent success.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me the following telephone stock quotations:

Bell of Mo.	$150@$151
Central Union	44@ 45
Chicago	375@ 400
Colorado	20@ 22
Cumberland	70@ 75
Great Southern	25@ 27
Iowa Union	16@ 19
Michigan	67@ 69
Rocky Mountain Bell	40@ 45
United	16@ 18
Wisconsin	104@ 106

W. A. K.

THE TELEGRAPH.

Repaving a Street for Operators.—Owing to the noise in Mulberry street, this city, the operators at Police Headquarters have been greatly hindered in their work. Work is now going on to replace the old cobblestones with asphalt.

Underground Wires at Lynn, Mass.—In a short time, or as soon as the city government street committee reports upon the subject, which will be favorably, the Woodward underground system of wires will be laid in Lynn for the telephone and telegraph wires. There is much feeling in Lynn favorable to the Woodward underground system, and no opposition.

Boston's Fire Alarm.—The Boston Fire Commissioners have made arrangements for a trial of a new feature of the Gamewell system of fire alarms. This will be used on one of the circuits connected with ten boxes, and by the device an alarm cannot be sent from any box while an alarm is going from another box on the same circuit. This will prevent the confusion sometimes caused at the central station when two alarms are given almost simultaneously from different boxes.

Signal Service.—Lieutenant Woodruff, U. S. A., is now on a tour of inspection of signal service stations. He has in hand also the arrangements for the cable to be laid between Capes Charles and Henry, and the one known as the Block Island cable. Although contracts have been entered into for the construction of these cables, their use will not be confined to the War Department, as it is understood that they can be utilized for commercial purposes. They will, therefore, be connected with the main lines.

Heavy Damages Wanted.—Samuel Dixon and other contractors have brought a suit against the Western Union Telegraph Company to recover $400,000 damages, claimed to have been sustained through the non-delivery of a telegram, which lost to the plaintiffs a contract with the Guatemalan government for the building of public works. The case came up before Judge Cullen in the Supreme Court, Brooklyn, last week, on a motion to make the plaintiffs answer specifically to the special defense that the message was not reported and no claim made within sixty days. Decision was reserved.

Bucket Shop Profits.—Mr. E. B. Ketchum, a Broadway broker, is now suing a bucket shop firm for profits due on turns in the market. It appears that Ketchum was in the habit of dabbling in stocks at the "bucket shop" kept by the men he is suing. He usually invested about $100 at a time, and he had lost about $1,400 when he invested in the New England stock at the time of the big rise, and was entitled to about $10,000 profit. The "bucket shop" proprietors said the transaction was too large and they couldn't fill it. They offered him $3,000, which he refused.

Land and Sea Rates.—Reports of a general cable and telegraph settlement are still plentiful in Wall street. It is positively asserted in some quarters that an agreement between Messrs. Gould and Mackay is under way, and that the basis of the agreement will be a general cable tariff of twenty cents. The Western Union managers assert that they are doing reasonably well at the twelve-cent rate, and believe that it could be made profitable in time, but a twenty-cent rate all round would be immediately remunerative and pay interest on all the money now invested in cables. The general opinion is that Baltimore & Ohio rates through the country will be shortly moved up to correspond with the Western Union rates.

Boston's Police Telegraph.—The first report upon the police telegraph and patrol-wagon system has been published, and is more than satisfactory. In June last the service was established in South Boston, the worst of the city districts, infested with hoodlums, and subject to constant rows and assaults and petty rebellions against authority. The service has been conducted without any need of special men for the switch-board and telegraphic department, the officers regularly in charge of the house having proved competent to attend to this in addition to their desk and detail work. Arrests have been made without the necessity of officers leaving their beats, large detachments have been easily delivered on a few minutes' notice at a fire or a disturbance, and arrests have actually diminished, owing apparently to the knowledge that a sufficient force could be so quickly brought to the relief of the patrolmen. A movement will be made to extend the system at once to one or two other rough districts, and also to those outlying ones where the officers have enormous beats to cover and cannot bring in prisoners without great difficulty.

THE TELEPHONE.

An Erie dividend of 1½ per cent. was declared last week, payable Oct. 25, to stockholders of record Oct. 18.

No Poles Wanted.—Justice Clement, in the Brooklyn City Court, last week granted a temporory injunction restraining the New York & New Jersey Telephone Company from erecting its poles in front of St. John's College, in Lewis avenue.

Nebraska.—The Nebraska Telephone Company paid their fourteenth quarterly dividend of 2 per cent., cash, on the 30th ult. The company are making extensive alterations and improvements in Omaha. The central office is to be moved into a building leased for a long term of years, where they will have ample room to grow. They will put in a Western Electric multiple board with an ultimate capacity of 5,000. All wires will be taken out of the building in cables to a distance of two blocks, and very many to a still greater distance. On the new routes in the business part of the town they are putting up 60-foot poles. They expect to be installed by about Feb. 1 in one of the neatest exchanges in the country.

Chinese at the Telephone.—A test of the long-distance telephone, the invention of W. C. Turnbull, of Baltimore, Md., was made on Oct. 17, between Washington and New York city, a distance by the route of the wire of more than three hundred miles. E. T. Barberie, a prominent electrician of New York city, conducted the tests at the Washington end. Cheng Tsao, the Chinese Minister, and other members of the Chinese Legation were present. At the New York end there were present the Chinese Consul General and his staff and others. The telephone was utilized in talking Chinese back and forth from New York to Washington.

Underground Wires for Boston.—It is stated that with a view of lessening the enormous damage caused by sleet storms upon aërial wire in and around Boston, the New England Telephone Company is making extensive arrangements to lay a large number of its wires underground in the thickly settled portions of Boston at as early a date as possible, and probably before winter sets in. In order to do this, an immense amount of cable will be required, and the company has placed an order with the Western Electric Manufacturing Company of Chicago for some 28,000 feet of Paterson underground cable of special quality, containing from 75 to 100 wires. The expense of this cable delivered in Boston ranges from 60 to 70 cents per foot; cost about $20,000, and the laying of the same will probably cost as much more, the entire cost being saved in two years in expenses of repairs caused by sleet storms. This 28,000 feet of cable, or over five miles, averaging, say, 85 wires per cable, will relieve the company of 4,000 miles of its aërial wire now in service, and is considered an excellent investment.

THE ELECTRIC LIGHT.

Willimantic, Conn., has a $10,000 electric light company.

Danville, Va.—Mr. G. L. Gerst has the contract for putting in an electric light plant.

Rapid City, Dak., is to be lighted by electricity. Mr. O. L. Cooper has the matter in hand.

The Pyle Electric Company, Akron, O., has been incorporated by B. F. Goodrich and others with a capital stock of $200,000.

Manchester, N. H.—Sowden, Elder & Wright have begun to install an American (Wood) plant at the Manchester Locomotive Works.

Search Lights.—Experiments are now being carried on with new search lights for the navy. The "Atlanta" and "Trenton" are already equipped.

The Municipal Electric Light Company, of Chicago, Ill., has been incorporated by J. W. Chisholm and others, with a capital stock of $60,000.

Carroll, Ia.—A committee consisting of R. E. Coburn, V. Hinrich, and W. J. Patterson is investigating the subject of organizing an electric light company.

Massillon, O.—The Massillon Schuyler Electric Light Company has now been incorporated with a capital stock of $50,000 by J. W. McClymonds, C. M. Russell and others.

Parkersburg, Va., in order not to have a tail place in the procession, has about decided to put in the electric light. The City Council has the subject under consideration.

Seneca Falls, N. Y.—The Seneca Falls Electric Light and Power Company, N. Y., has been incorporated with a capital stock of $20,000 by S. S. Phillips, H. T. Hayes, and others.

To Rebuild.—The Brush Electric Light Company gave notice last week to the Bureau of Buildings that it would rebuild its Elizabeth street factory, lately burned, at a cost of $40,000.

Dividends.—The Edison Illuminating Company of New York has paid its quarterly dividend of 1 per cent. The Fall River, Mass., Electric Light Company has paid 2 per cent. for the last quarter.

Electric Light at the Vatican.—We learn that Messrs. Siemens and Halske have received instructions to light the Vatican by electricity. The work is to be completed by the end of the year.

Portsmouth, N. H.—The Portsmouth Electric Light Company have started up their new station. The installation is a great success. They are using the Armington & Sims engine to furnish power.

Increasing Its Stock.—The Municipal Electric Light Company held a meeting at 91 Broadway, Williamsburg, Long Island, last week, and decided to increase the capital stock from $250,000 to $500,000.

The Waltham, Mass., Electric Light Company have decided to start their station this fall. They have ordered two Armington & Sims Company's engines of the Jarvis Engineering Company, Boston, and will use both arc and incandescent lights of the Thomson-Houston system.

"Pushing Young Particles."—Messrs. Charles T. Hughes and Howard L. Browning, general agents for the Edison United Manufacturing Company, under the firm name of Hughes & Browning, and with offices in the Crouse Block, Syracuse, N. Y., have placed no fewer than 4,200 isolated Edison lights since August 4, and they regard that as only a "dog days'" performance!

Woonsocket, R. I.—The contract for enlarging the station of the Woonsocket Electric Light Company, Woonsocket, R. I., so as to run incandescent lamps, has been awarded to the Jarvis Engineering Co. They will put in another 150 horse-power steel tubular boiler, set with the Jarvis furnace, and a 60 horse-power Armington & Sims engine.

Detroit, Mich.—The new station of the Brush Electric Light Company will, it is said, be one of the largest and most complete in the world. It will stand on a lot 150 × 350, and will be 100 × 200 and two stories high. The fine Edison station is about ready for business. Detroit may well be proud of its electrical enterprises and those engaged in them.

Erie, Pa.—Among the improvements in business throughout the country may be noted that at Erie, Pa., where everything is lively, and where the Ball Engine Company are about to move into their new and commodious factory. The firm have been running night and day all the year in their efforts to keep up with their rapidly-growing business. The firm have supplied a large number of engines for lighting purposes.

Vanderbilt's yacht "Alva" has been launched. She will be lighted throughout by electricity, which will be supplied by a Siemens dynamo and engine located in the engine-room. In addition, there will be a very powerful search-light forward in the peak, which will be capable of lighting up the sea a distance of from six to eight miles ahead. Her main set of signal lights will also have an electric attachment by which they can be made to double their ordinary efficiency.

Head-lights.—The motive power department of the Pittsburgh, Cincinnati & St. Louis road at Columbus, O., has been quietly engaged for a good while in perfecting the electric head-light for locomotives. Several improvements have been devised by Mr. Wall and his assistants, and the promise of entire success in this direction is excellent. Some of the strongest objections urged against the use of the electric head-light have been proved to be theoretical merely, while its advantages are real and important.—*Railway Master Mechanic.*

Newton, Mass.—The Jarvis Engineering Company, Boston, Mass., have been awarded the contract for erecting the station for the Newton Electric Light and Power Company, Newton, Mass. They will put in a 70 horse-power Armington & Sims engine, a steam tubular boiler set with the Jarvis patent boiler setting, and using National rocking grates to burn screenings for fuel. The boiler will have the celebrated Martin door, National feed water heater and Korting double-tube injector. The station will be built two stories high and the upper lofts let to furnish power for manufacturing purposes. The boiler-house will be of brick, with room eventually for 500 horse-power of boilers. The station will be made large enough to furnish power for the Newton Street Railway Company, to be run by electricity. A large demand has started all over the city for incandescent lamps to be used for house lighting.

Pittsburgh, Pa.—The Allegheny Valley Electric Light Company is rebuilding, remodeling and enlarging its old station, without cutting a wire, shifting an engine or changing the shafting. The new building will have a frontage of 90 feet, running back 60 feet to a private alley. The new boiler-house will have a capacity of 2,000 horse-power, whereas that of the old boiler-house was only 425 horse-power. The capacity of the old generating room was 450 arc lights; that of the new one will be 1800 incandescent lights and 500 arc lights. In order to prepare for the heavy engines new and extensive stone foundations had to be laid, and this was done without even lifting the old engines. These engines will be four in number, of the Corliss make, and each of 500 horse-power. The fly-wheels will be 18 feet in diameter, and the fly-wheel pits 14 feet deep. There will be four lines of shafting to operate 38 dynamos, and so arranged that they can be disconnected in sections and each dynamo cut off at the will of the operator in charge. The work is being done under the direction of Mr. S. A. Duncan, the superintendent, and goes on night and day.

APPLICATIONS OF POWER.

Long Island.—There is a report that street car directors in Brooklyn are considering the adoption of electric motors. The question of establishing an electric railway to connect Cedarhurst, the Isle of Wight and Far Rockaway, the terminus of the latter to be somewhere near the Long Island Railroad station, is also being discussed.

The Bentley-Knight System.—The representatives of the Third avenue surface railroad have been visiting Providence to examine the Bentley-Knight motors. These they believe will be satisfactory, and Superintendent Lyon has given the owners of this system permission to operate on 125th street and demonstrate the capabilities of their system. There is no doubt of the fact that the Third avenue company is going to take off the horses just as soon as possible.

Broadway, New York.—All the corporations that claim the right to build railroads under Broadway—the New York District Railway Company, the Arcade Railway, the New York Underground Railway Company and the Broadway Underground Connecting Railroad Company—were represented before the General Term of the Supreme Court on Oct. 15, when the petition of the first-named company for the appointment of Commissioners to determine whether it should be allowed to build, was set down to be heard. The other companies and the city will oppose the application. To enable all the parties to exchange papers and get the record straight, the hearing was adjourned until Oct. 27.

A Waterhouse Motor.—The Waterhouse Electric Manufacturing Company, of Hartford, Conn., have completed experiments in motors to such an extent that they make a report which is interesting. In the words of the company: "We have a motor for high tension currents and can produce a uniform speed regardless of changes in the external resistance. We have run the motor from a generator operating arc lights and have turned lights on and off without change of speed in the motor. The regulation of the speed is so fine that absolute uniformity is at all times retained." As this motor will run on any arc circuit, even with arc lights burning on same circuit, it should be in demand among the electric light companies who are all ready for a motor such as this promises to be.

News from Out of Town.—After Nov. 1 the fare on all the elevated roads at all hours of the day will be 5 cents, and a month later it is expected that the introduction of electric motors will revolutionize travel on two of the lines. The new locomotives are very powerful, and will be specially adapted to the heavy grades. The Third Avenue Horse Car Line is also thinking of making a trial of electricity for its surface road. The cable men would like it, and a new company that proposes to go "up hill and down dale," from the Hudson River to Long Island Sound above the Harlem River will depend on electric motors to take the trains up hill at the rate of fifty miles an hour. This company does not intend to grade a line for its tracks, but to follow the natural lay of the ground and go over the hills which others would tunnel.—*Phila. Record.*

"The World Moves."—In the course of an able and well-informed article on electric motors and the proposal to use them on the the Third Avenue car line in this city, the *Commercial Advertiser* says: "It indicates that business men are becoming aware of what has been known for some time in scientific circles, that the electric railway is no longer an experiment, but that it can compete in efficiency and cheapness with any other known system of transportation. The action of the Third Avenue railway directors is to be hailed with satisfaction. The world moves, and the prospect is that the world will hereafter be assisted in moving by electricity. If there were any doubt about the success of the electric railway for heavy work with a large number of trains, the test here at Third Avenue would be a decisive one and well worth the making."

PERSONALS.

Mr. John G. Moore, who has just been made a director of the Western Union, built the Mutual Union lines, and came to this city—a Maine lad—with a load of lumber after the war.

Mr. F. A. Gower, who disappeared so suddenly with his balloon at sea off Dieppe, France, is now said to be living on Malabar Hill, Bombay, while his brother, Mr. G. L. Gower, takes care of his telephone interests in Europe. The story seems wildly improbable.

MISCELLANEOUS NOTES.

Signaling on Men-of-War.—A committee has been ordered to assemble at Portsmouth, Eng., to consider the whole subject of mechanical, electrical and voice communication between the decks and engine rooms of men-of-war.

Clocks for Railways.—The Rapid Transit Railroad Company, Staten Island, is putting electric clocks and signals along the entire length of its roads, so that automatic signals will be given of the passage of trains, or of caution.

New York Subway Matters.—At a meeting of the Subway Commission held on the 19th inst., Mr. J. E. Smith, Superintendent of Fire Telegraphs, obtained permission to run cables in the conduit uptown on Sixth avenue. Engineer Kearney was ordered to report on a 20-foot conduit plan for 125th street.

Buffalo Electrical Society.—At the meeting of this society on Oct. 15, Mr. George H. Usher, chief operator of the Baltimore & Ohio Company, Buffalo, read an interesting paper on troubles with underground and submarine wires. Mr. Usher expressed the opinion that the time would come when it would be no more difficult to operate an underground system than is experienced to-day in working an aërial one. At the next meeting of the society William Finn will begin the first of a series of lectures on elementary electrical subjects.

A Useful Door Bell.—The ringing of the electric door bell roused Captain C. G. Lyon from his slumbers at the family residence on Golden Hill, Bridgeport, last week. He found the hall full of smoke, and discovered that a box of ashes in the cellar had ignited and the blaze had communicated to surrounding woodwork. A hand extinguisher quickly quenched the fire, and but little damage was done. The wire of the annunciator passed over the spot where the blaze started, and the heat had lengthened the spring and permitted the closing of the circuit, which caused the bell to ring.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks:

OCTOBER 19, 1886.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	40	42
Am. Tel. & Cable	75	76½
Cen. & So. Am.	75	100
*Com. Tel.	103¼	104
*Gold & Stock	90	95
*Inter. Ocean Tel.	.....	95
N. Y. Mutual	67	70
Pac. & Atl.	45	55
*Postal T. & C.	15	25
South. & Atl.	65	75
W. U. Tel.	76¾	76⅞
W. U. Scrip.	64	.....
W. U. Bonds	.....	123
Mut. U. Bonds	87⅝	87½
TELEPHONE.		
Am. Bell	211½	.....
Am. Speaking	100	115
Erie	27½	28
*Hudson River	.....	55

TELEPHONE.	Bid.	Asked.
Mexican	1⅛	1⅜
*N. Y. & N. J.	78	85
N. Y. & Pa.	25	30
New England	44⅜	45
*Southern Bell	100	130
ELECTRIC LIGHT.		
*Am. Electric	.....	16
*Brush	.....	.....
*Brush Ill	.....	.....
*Consolidated	.....	.....
*Daft	.....	100
*Edison	125	130
*Edison Ill	90	.....
*Edison Isolated	40	.....
*United States	40	50
*U. S. Ill	50	.....
MOTOR.		
*Daft	.....	.....
*Sprague	600	.....

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

SPARKS AND FLASHES.

An Important Telegraph Message.—At one of the downtown police stations is a patrolman who is noted for his penuriousness, and the boys are perpetually endeavoring to devise some scheme to cause him to spend money. Early last evening a district telegraph boy waltzed into the station with a dispatch for the above-mentioned officer, on which there were thirty-eight cents to pay. With a sigh of deep regret the officer thrust his hand into his pocket and after a long parting look of sadness, relinquished his grasp on the coin. The dispatch read:

"Mr.——: How are the cats on your beat?"

The scene that followed is beyond the power of description.—*Boston Herald.*

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting tools, etc.

Magnetism in Watches.—

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, 216 *La Salle Street*,
Manager Western Department.

CHICAGO, Feb. 10, 1885.

Messrs. Giles, Bro. & Co.:

GENTLEMEN: I have now been carrying my watch encased in one of your Anti-Magnetic Shields for about a year, and it affords me pleasure to state to you that notwithstanding I have been very much about dynamo-electric machines during the time named, the anti-magnetic case seems to protect the watch perfectly from the magnetic influence of the machines. I have not made any special electrical tests, inasmuch as I regard the good running of the watch as all that is necessary. I am thoroughly convinced, from the effect upon my own watch, that the case is an excellent protection, and I may almost add an absolute preventive of magnetic influence from external sources to the delicate movements of a watch. My watch is a Howard watch, and during the period of two or three years previous to encasing it with your anti-magnetic case it had varied to a very great extent, and I had it demagnetized on two different occasions. I regard your case as a complete success, and if my indorsement of same is of any value, you are at liberty to use it.

Yours truly,

C. C. WARREN, *Manager Western Dept.,*
The U. S. Electric Lighting Co.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED OCT. 5, 1886.

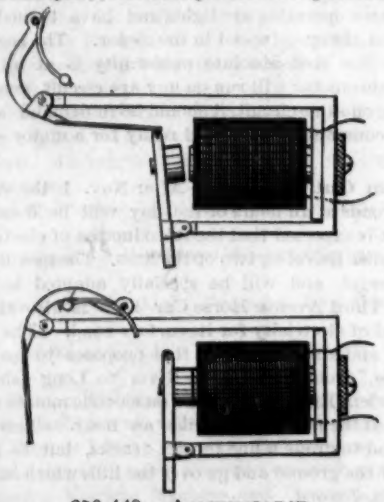
350,126. Electric Fire Extinguishing and Alarm System; Joseph W. Frost, Rochester, N. Y. The invention consists of devices for automatically turning on water in case of fire, and also devices for dropping an annunciator and sending a local and a district alarm.

350,130. Induction Coil for Telephone Service; Evelyn B. Hamlin, Chicago, Ill. The first claim describes the construction: "An induction coil consisting of a primary coil of coarse wire surrounding a soft-iron core, a primary induction coil of fine wire the terminals of which are designed to be connected with the line and ground respectively, a continuous secondary induction coil of fine wire, with the terminals of which a local circuit may be formed, and a primary extension coil of coarse wire connected with said primary coil and surrounding the whole, the terminals of said primary and primary-extension coils being in circuit with a local battery." The object is to so construct an induction coil for telephonic service that the current from a local battery may be utilized to induce a line-current upon a secondary or sub-coil, and to amplify a local induced current in a third sub-coil, and so eliminate the usual objectionable effects upon the receiving instrument of line induction. See illustration.

350,140. Electric Arc Light; Geo. M. Lane, Asbury Park, N. J. The carbon-holders are supported upon racked segments, and the segments are fed by driving pinions controlled by the main and shunt magnets.

350,160. Telephonic Apparatus; James W. See, Hamilton, Ohio. As a means of providing against the danger of a transmitter battery becoming too weak, and also for furnishing a convenient call apparatus at a subscriber's station, a test bell is put in the circuit of the battery and is given such a resistance that it will not operate unless the battery is strong enough for use with the transmitter.

350,177. Electric Winding Device for Clocks; Wm. F. Weisgerber and Ida C. Himmer, New York, N. Y., Assignors by direct and mesne assignments to the Standard Electric Clock Company, of same place. The pendulum of a clock



350,449. ANNUNCIATOR.

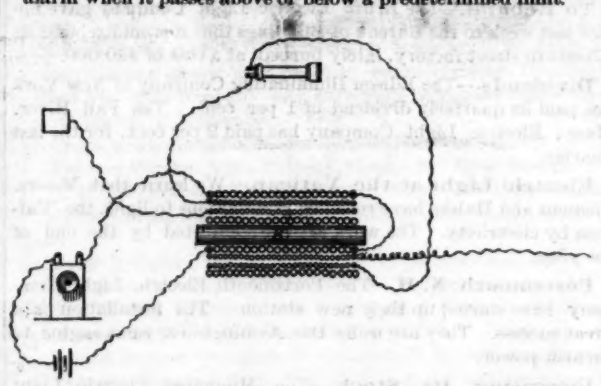
operates to close the circuit of an electro-magnet. When the armature of the latter is attracted it raises a weighted lever which winds the clock-spring.

350,203. Telephone Attachment; John T. Lister, Cleveland, Ohio, Assignor, by direct and mesne assignments, to James C. O'Neil, and Charles A. Dainz, both of same place. The attachment consists of a succession of funnel-shaped chambers joined together at their ends, each chamber having its apex toward the telephone transmitter and its base toward the speaker.

350,215. Telephone Transmitter; Frederick G. Sargent, Westford, Mass. The transmitter diaphragm passes into a conducting liquid, and is there located between the terminals of two branches of the primary circuit of the transmitter. The act of speaking causes the diaphragm to vibrate between the terminals.

(1) 350,234. System of Railway Signaling; (2) 350,235. Railway Telegraphy; Thomas A. Edison, Menlo Park, N. J., and Ezra T. Gilliland, Boston, Mass., Assignor to the Railway Telegraph and Telephone Company. Improvements on the system described in THE ELECTRICAL WORLD of March 6, 1886.

350,279. Electric Water-level Indicator; Charles H. Wickersham, Pottstown, Pa. The object is to indicate constantly the height of water in steam boilers, and to sound an alarm when it passes above or below a predetermined limit.



350,130. INDUCTION COIL FOR TELEPHONE SERVICE.

(1) 350,293. Electric Bell Cord; (2) 350,294. Electric Battery; Harry B. Cox, Cincinnati, Ohio. (1) A coupler for making good electrical connection between the wires of an electric bell cord. (2) A battery element having its exerting fluid thickened to the consistency of jelly by some substance, such as gelatine, which will ferment and so assist in the action of the fluid.

(1) 350,296. Utilization of the Residual Liquids from Batteries; (2) 350,297. Protective Coating for the Electrodes of Batteries; L. A. W. Desruelles, Paris, France. (1) Consists in converting the residual products of the bichromate battery into paste, drying and dividing them into cakes which can be employed in weaker batteries, such as those used for telegraph purposes. (2) A coating consisting of grease and mercury mixed.

350,299. Mode of Electric Communication; Amos E. Dolbear, Assignor by mesne assignments to the Dolbear Electric Telephone Co., of New Jersey. Relates to a method of establishing electric communication by telephone between two or more places without the use of wire or other like conductor. For description, see page 198 this issue.

350,312. Door-catch adapted to be Operated by Electricity; Wm. H. Markland, Brooklyn, N. Y., Assignor to Tucker & Baxter, of same place. The catch consists of a spring bolt provided with a stop, and an electro-magnetic releasing device.

350,320. Autographic Telegraphy; Jas. H. Robertson, Brooklyn, N. Y. The strength of the current is varied by varying the pressure on a series of carbon discs included in the circuit, this feature constituting an improvement on an invention described in a former application of the same inventor.

350,355. Insulating Coupling for Combined Electric Light and Gas Fixtures; Chas. S. Forsyth, Philadelphia, Pa. The weight of the chandelier tends to make the coupling gas tight.

350,365. Insulating Clamp for Electric Wires; John W. Holdsworth, St. Louis, Mo., Assignor of one-half to Robert Dodsworth, of same place. The clamp is slotted through, parallel with its broad sides, except at a point near one edge, and is held together by the screws which attach the clamp to a wall. The object is to admit of the independent release of the various wires and also to afford a flexible support.

350,411. Automatic Circuit-Closer for Railway Signals; William Buck, Kilburn, England. The depression of the rail caused by a passing train imparts a reciprocating movement to a box containing mercury and produces waves in the mercury to make or break contact with a central wire.

350,426. Automatic Electric Fire Alarm System; Joseph W. Frost and Stephen B. Lake, Rochester, N. Y. The object of the invention is to cause an automatic local and district alarm in case of fire; to drop annunciators indicating what section of the building is threatened; to afford means for testing the apparatus without sending in an alarm, and to provide against false alarms.

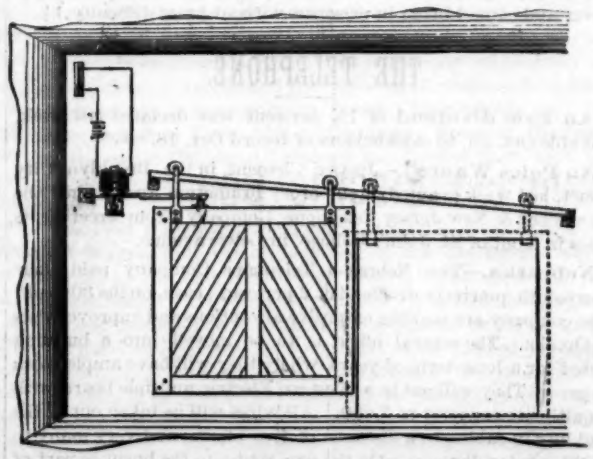
(1) 350,430. Electric Time Indicating System; (2) 350,431. Primary Electric Clock; (3) 350,432. Electric Time Indicating System; (4) 350,433. Secondary Electric Clock; (5) 350,434. Electric Time Indicating System; Chas. A. Hussey, New York, N. Y. The patents cover a system of primary and secondary clocks, together with details.

350,445. Apparatus for Vaporizing Liquids; Ephraim B. Potter, Paducah, Ky. The liquid is thrown in the form of a spray upon wires heated by electricity.

(1) 350,449. Annunciator; (2) 350,450. Case for Medicine Bottles; (3) 350,451. Appliance for Closing Openings in Buildings Automatically Charles A. Tucker, Islip, N. Y., Assignor to Tucker & Baxter, of Brooklyn, N. Y. (1) The object of the invention is to simplify and improve the construction and operation of the "drop" or "indicator." Each drop is supported on a metallic frame composed of an upper and a lower arm, parallel to each other, and a vertical part connecting them, conveniently made of one piece of metal bent into the required shape, the vertical portion of which may be readily screwed or otherwise rigidly secured to a bar at the back of the annunciator case. See illustration.

(2) A device for sounding an alarm when a vessel containing poison is removed from its place. The object is to warn clerks in drug stores.

(3) The apparatus consists essentially of a series of closing-doors adapted to move across their openings automatically when free, the doors being provided with suitable detents and catches to engage with them and hold the doors open, and armatures to actuate the catches and release the closing-doors, in combination with a series of magnets arranged to attract the armatures, electrically connected with each other and with the poles of a battery, and a series of thermostats adjusted to close the circuit at determined degrees of temperature, and electrically connected with each other and with the other pole of the battery and with the magnet-wires, and adapted to complete



350,451. APPLIANCES FOR CLOSING OPENINGS IN BUILDINGS AUTOMATICALLY.

the circuit and excite all the magnets in the series when the circuit is closed by any one of such thermostats. See illustration.

350,469. Printing Telegraph; D. Bryce Scott, Brooklyn, N. Y., Assignor to the Western Union Telegraph Company, of New York. The object of the invention is to provide the vibrating mechanism of printing telegraphs with buffers to prevent noise and to render the apparatus less subject to wear. The buffers are made of sole leather, vulcanized fibre or other non-resonant tenacious material.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.